AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 16, NO. 30. WEEKLY. | NEW YORK, THURSDAY, JULY 27, 1893. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

COPYRIGHT 1893, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

A New Universal Milling Machine.

We present herewith an engraving of a newly designed universal milling machine, which represents the latest practice of the Brown & Sharpe Mfg. Co., of Providence, R. I.

It will be perceived that in its general features the new machine does not depart from the original design, with which our readers are familiar, but in some points improvements have been made that are worthy of note, and will, it is believed, add to the efficiency of the machine. Our present article will be devoted mainly to these changes and the advantages gained by them, rather than to a general description of the machine.

The overhanging arm is provided with a bearing for the outer end of the arbor, and an adjustable center as well. The arm is also intended to be reversed end for end, the plain cylindrical end then being adapted to receive any kind of special attachment.

The spindle is of steel, with ground and lapped journals running in bronze bearings adjustable for wear. There is a hole entirely through the spindle, and the end is threaded for the reception of chucks, face-plates, etc. The cone pulley has three steps for a 3½″ belt, and there are back gears, giving six changes of speed.

The spiral head is of the Lipe pattern, which gives the minimum height of the work from the platen when the head is elevated, and the worm shaft is mounted in eccentric bearings by which it can be readily disconnected from the worm-wheel, and when so disconnected numbers below 24 can be indexed rapidly by means of the index plate on the spiral-head spindle. The foot-stock center can be raised vertically or inclined at an angle, thus providing for taper work with the centers in line with each other, the movement and adjustment of this center being by mechanical means that give control of it and make its adjustment an easy matter.

The platen can be handled from either end, there being a crank handle at both ends of the feed screw. The feed arrangement is entirely changed, the screw being now driven from the center of the swiveling plate. The motion for this is derived from the vertical shaft seen at the rear of the elevating screw, this being driven from the feed cones at the back, where provision is made for sixteen changes of feed ranging from .003″ to .22″ to one revolution of the spindle. The feed is automatic in either direction, and is reversed by the movement of the small lever seen in front of the saddle. It is automatically thrown out in either direction by the adjustable dogs seen at the side of the platen.

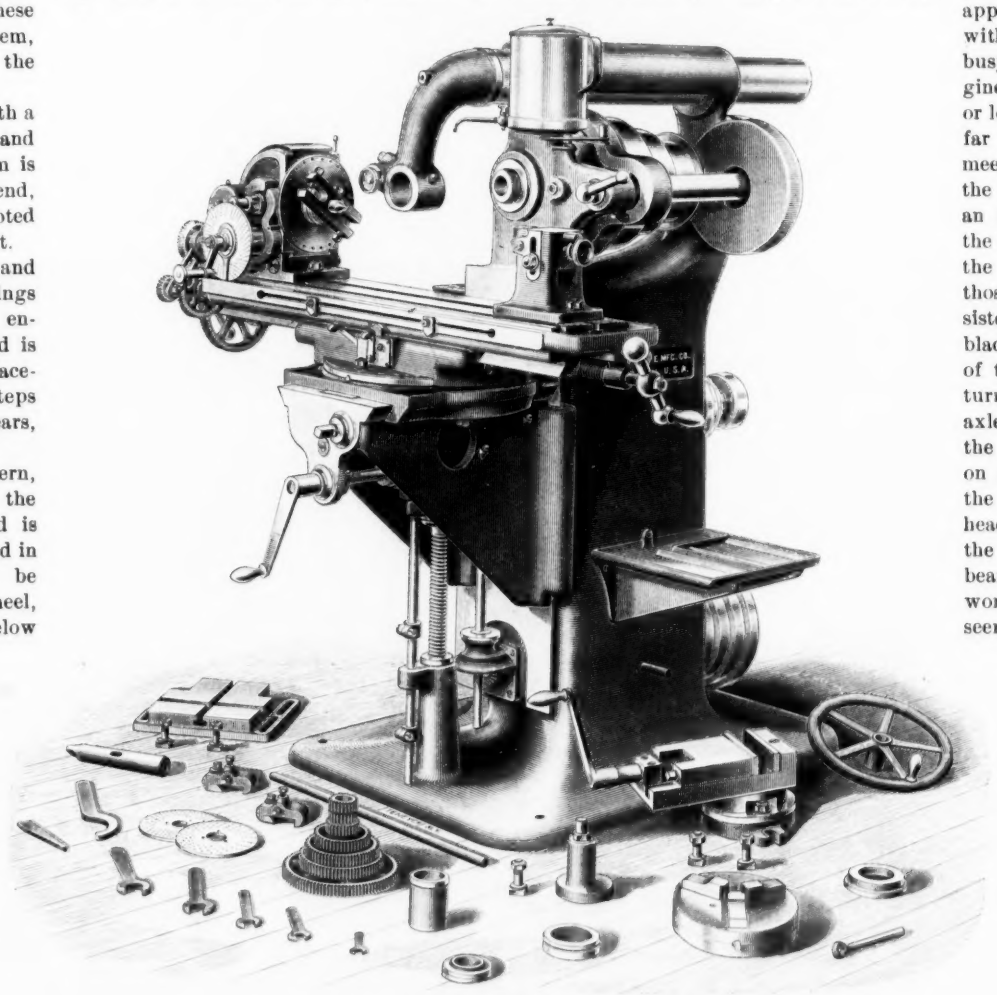
The platen swivels to any angle up to 45° either way, and is clamped by three bolts, which slide in circular T-slots in the saddle.

The elevating screw is brought out from the column, so that it is nearly under the center of the weight it has to support, while the rod which carries the stops for the vertical motion is in front of it, and is not threaded, but plain, with sliding stops that are readily adjusted and clamped in position. Both the saddle and knee are clamped by fixed handles, thus doing away with the use of wrenches for this purpose.

The graduated dials can be adjusted without the use of a wrench or screw-driver.

The taper holes in the main and in the spiral head spindles are the same, ½″ to the foot, and 1¼″ diameter at the small end, and the threads on the spindles are also alike

Work 12″ diameter and 21″ long is taken upon the centers, and the principal dimensions of the machine are as follows: Largest step of cone, 11″; distance from center of spindle to under side of overhanging arm, 6″; distance from end of spindle to center in overhanging arm, 17½″; working surface of table, 40″x8″; transverse



A NEW UNIVERSAL MILLING MACHINE.

movement of table, 7½″; greatest distance table can be lowered, 18½″; automatic feed, 25″. Net weight, 2 860 pounds.

In the covered back gears, in the doing away with cut and finished surfaces, where these do not add to the working qualities of the machines, and in other respects as well, the modern tendency of machine tool designing is apparent, and the machines of this style shown at Chicago are remarkable for their neat appearance and compactness.

Locomotives and Other Early Machines.

BY W. H. BOOTH.

There has of late been much both spoken and written of the early days of the locomotive, and there appears to be a very general impression that the old surviving examples represent the state and condition of mechanical engineering existing in those early days. This I consider is quite an erroneous supposition which still existing evidence does not support, and I consider that the quality of the work put into the early locomotives in no way teaches us anything of the mechanics of the day. The lesson to be learned is quite otherwise. These remarks are prompted by my knowledge of existing examples of work which antedate the locomotive by many years, and by others which are about its contemporary. These examples are very far ahead indeed of the quality and style of workmanship of the Rocket, for example, or the Agenovia, both of which early locomotives are, I believe, now at Chicago. The early examples I have in my mind are chiefly old stationary engines for mill driving. One of these, a beam engine, rated at 40 horse power and usually worked at 200 or over, was running until the last few years in a flouring-mill which bore date 1824, and a similar engine of 60 horse-power worked regularly at over 300 horse-power in a spinning-mill from about the year 1829. The latter is still in existence, though not working, and a few years ago it was compounded by the addition of a high-pressure cylinder placed midway of the connecting rod half of the beam in the manner known as McNaughting. It will run now at 80 pounds boiler pressure, but though originally constructed to work at only 7 pounds, the whole of the original engine, except a few smaller parts, is still there as at first, and has no semblance to the rough workmanship of the early locomotives; and the same may be said of other beam engines dating as far back as 1800, though speaking generally I should say that the beginning of the century marks the commencement of the still existing style of workmanship.

How is it then, we may ask, that the early locomotives are of such a rough class of work? To me this is to be explained very simply, after all. Railroads owe their existence to an era of activity brought about by the application of the condensing steam engine of Watt to industrial purposes. The impetus thus given to trade overflowed the existing means of communication; the roads were full of teams, and the now wayside villages of England were then busy places, for they lived largely out of the stage coach and wagon. Then the locomotive put in an appearance, but like all new ideas was met with incredulity. It found the workshops busy making stationary mill-driving engines or filled with orders for mill gearing or looms, and an order for a locomotive, so far out of the regular run of work, would meet with about the same appreciation from the best shops as would to-day an order for an experimental flying machine from, say, the Niles Tool Works. The result was that the early locomotives were made largely by those immediately interested in them, assisted by probably odd workmen or colliery blacksmiths. Indeed, they bear the stamp of the smithy on every part, and only the turning of the crank-pins, piston rod and axle bearings show any acquaintance with the tool shop, though contemporary work on stationary engines is quite elaborate in the turning of gudgeons, end pins, cross-heads and the ornamental bosses with which the Low Moor Iron Works finished off the beam ends of their large engines. In the work of the present day we have ourselves seen much the same thing happen in the case of the earlier dynamos, wonderfully plastered up with bits of brass and solder, and quite different from the solidly-built machines which an established trade can build in a properly organized workshop. We do not measure the mechanical skill of to-day by the plumbers' botching of those early dynamos, and similarly we cannot assume that the difference observable between the Agenovia and a modern locomotive represents the progress in mechanics during sixty years. This really tells us that the locomotive was a kind of poor relation in the early days, and not considered worth while for good workmen to be employed upon. It is only possible to learn the true state of any art at a gone period by studying its higher developments, for the lower developments of to-day, such as may be found in far back country, will closely resemble the rough work of any period.

The earlier spinning frames of Arkwright, one of which I have seen, were very much rougher in workmanship than other light machinery existing at the same time, and probably the same would be found in many other instances of new inventions, the inventor, as a rule, having been too limited in funds to obtain the services of the best workshops, and if not poor to begin with the British Patent Office would take care that he was made poor by the exorbitance of its demands As recently pointed out in one of your English contemporaries, the only cheap patents in this country are those for articles of the kind which go off with a fizz and become worthless before the fees become due; and this is the class of article

made so largely in Birmingham, whose M. P. at the time had control over the new Patent Act. This man peddled in this manner to his own constituency and neglected the remaining 99 per cent. of the country, and yet to-day is loud as any one in his talk of Imperialism. I suppose he fancies the making of a new crown would fall to Birmingham.

Smith Shop of Toledo Manual Training School.

It is essential that schools and institutes in which young men are trained in the manual part of a trade should, in their workshops, be equipped in the most approved manner for the work to be done, it being a part of the training of the students to learn how to do work and how work should be done in the best manner and with the most agreeable surroundings, at least, so far as these surroundings would tend to economy in shops where work is done for commercial reasons only. To show how this is arranged for in the Toledo Manual Training School, Toledo, Ohio, we present a perspective view, and above it a plan of the Smith shop at this institution.

The perspective view is an exact reproduction of a photograph, and shows the general arrangement as far as is practicable in one view of the kind. There are different sizes of forges—for light and heavy work—which is not quite clearly shown in the engraving.

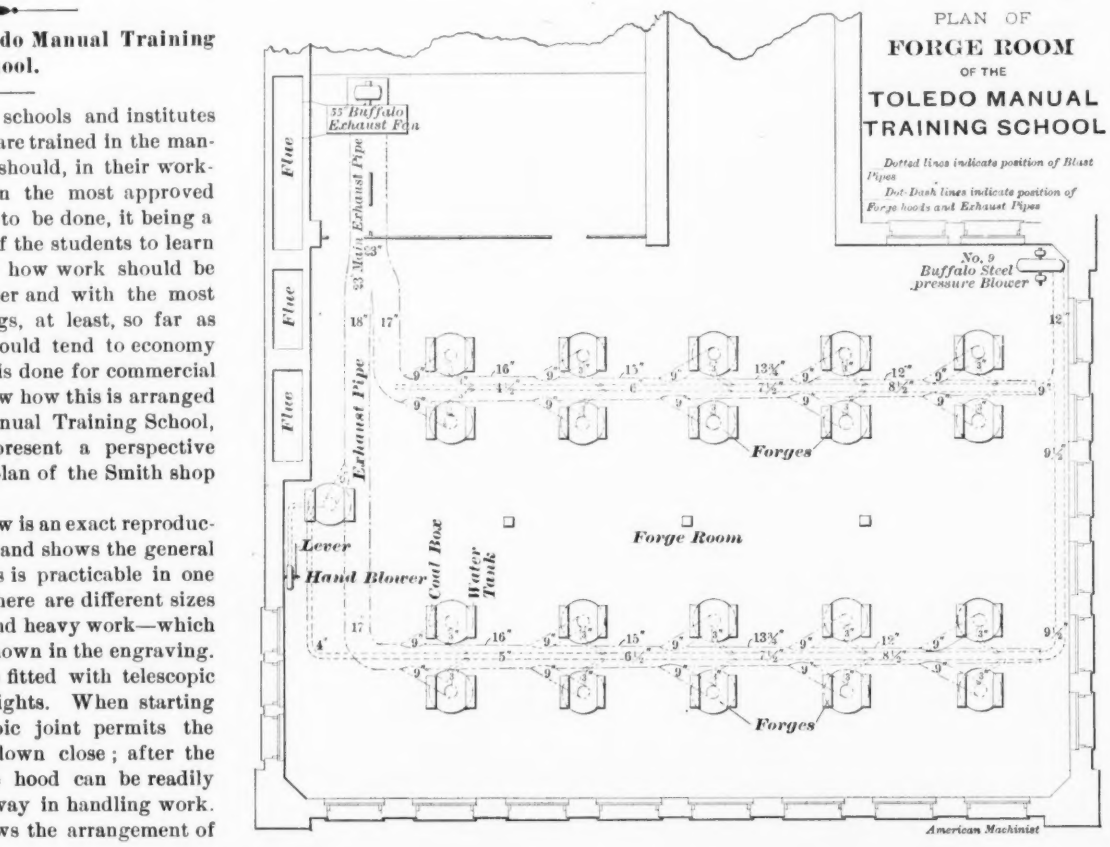
The hood pipes are fitted with telescopic joints and counterweights. When starting the fire the telescopic joint permits the hood to be brought down close; after the fire is well going the hood can be readily raised up out of the way in handling work.

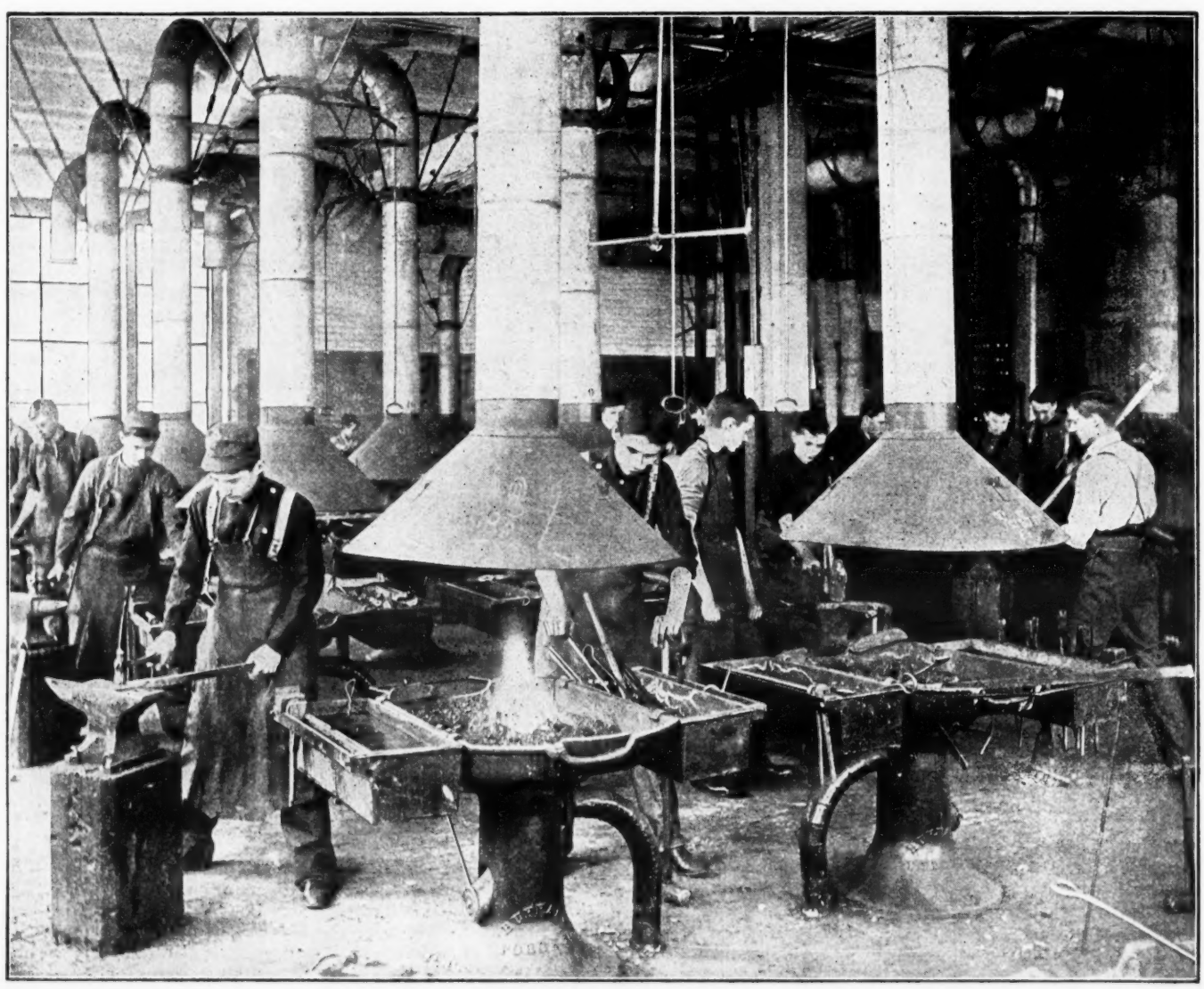
The plan view shows the arrangement of the exhaust pipes through which the smoke and foul air are removed and the blast pipes for the fires; also the location of the exhaust fan and the pressure blower, so arranged on a bed that by means of a screw the tension of the belt can be regulated at will.

The complete outfit for this shop was furnished by the Buffalo Forge Co., of Buffalo, N. Y., which company, we are informed, has furnished the equipments — consisting of forges, blowers, exhausters, hot-blast heating and ventilating apparatus, punches, shears, drills, etc. —for more than fifty manual training schools in this and other countries.

The Engineer (London) has this to say for the engineers and fireman of the ill-fated "Victoria."

"Much has been said of the gallantry and chivalry of the officers and crew, but nothing can, we think, have, under any circumstances, exceeded in merit the conduct of the engineer officers and the firemen. When the ship was reeling to destruction, they kept to their posts, and orders telegraphed from the deck to the engine room were faithfully carried out. Nelson's famous signal floats before us, and our sorrow is tempered and all but lost in admiration for the men to whom duty was nearer and dearer than life."





SMITH SHOP OF TOLEDO MANUAL TRAINING SCHOOL

Columbian Exhibition Notes—IX.

Editorial Correspondence.

GERMAN MACHINE TOOLS, CONTINUED.

Besides the special lathe described last week there are several machines in the exhibit of J. E. Reinecker that embody some of the same principles, these being, for the most part, simpler machines intended for backing off and clearing cutters such as those of irregular form, gear cutters, etc., these machines not having the regular lathe carriage, but merely the double compound rest described last week, which enables the clearance to be given at any desired angle. They show gear cutters made in such machines, these cutters being in two parts, which are placed together on the arbor to make the complete cutter. Fig. 37 (page 3), though not a gear cutter, will serve to show the construction, this being a 12-tooth cutter with six of its teeth on each half of the cutter. The teeth are overhung in the manner shown and alternate pairs of the teeth are cut out so that the teeth of each part interlock with those of the other, the curious feature of the case being that the clearance on the two parts is lateral as well as radial and in opposite directions on the two parts; *i. e.*, the teeth on one part of the cutter are cleared to the right while the others are cleared to the left; this making it necessary to cut away that side of each tooth that would have no clearance, or rather negative clearance. It is evident, of course, that as the teeth of such a cutter are ground back to sharpen them, they get thinner, and to compensate for this the two parts of the cutter must be packed apart the proper distance by washers.

Wherever a cutter has parts of its cutting edges that are exactly radial, a radial reciprocating motion of the forming tool fails to give clearance to those parts, and it is this difficulty which our German friends have evidently sought to overcome; a difficulty which sometimes manifests itself in the case of epicycloidal cutters which have a point at and near the pitch line which is radial and consequently not backed off. There is no such difficulty with involute gear cutters, and in fact there are not very many cutters used in American practice of milling but what can be made to work satisfactorily by the ordinary means, the reason seeming to be that as the cutting edge approaches the radial line the amount of work it has to do decreases, until when it becomes radial it has no cutting whatever to do, theoretically, and is only dulled practically by its rubbing contact with surfaces already cut to form. It is quite common with us to clear such a cutter slightly by hand scraping at such points—so slightly that the diminution of size by grinding is not noticeable, and yet sufficient to make the cutter work well.

There are a number of very good cutter grinders shown, one of these being arranged so that the knee and slide carrying the centers and heads for holding cutters can be swung around the cylindrical column, to bring the work to the periphery or to the front face of the wheel as may be desired.

A very large and heavy universal milling machine is shown, the "ground plan" of it being something as shown in Fig. 38, which, of course, is a mere outline sketch not drawn to scale, and in which *a* is the platen, 14 inches wide, this resting and swiveling upon a saddle which reaches from front to back over the bed, a distance of 44 inches. The clamping of the swiveling slide to the saddle is at either side of the center through the graduated plate and also at each end of the platen. Upon the platen the usual head and foot stock are placed, these being capable of swinging work 16 inches diameter, and 35 inches long. The arm *b* unites the outer support for the arbor with the spindle saddle *d*, both these moving vertically upon suitable slides. The cone pulley is placed in the space marked *e*, and is at a fixed height; connection with the spindle gear being by means of an expansion train which passes through an opening in the upright. The outer support can be moved to or from the head and secured at any desired distance from it by means of the T-slots indicated. The spiral head is the same as Brown & Sharpe's older design, except that the index is differently arranged. The index plate has but one hole in it, and the crank by which it is turned is not on the same shaft, but is on the worm shaft, a train of compound gearing connecting the two, so that as the worm shaft is turned the index plate is also turned, but at a different

rate, depending upon what gears are used, such gears being used for each division that the proper amount of motion is given the worm during one revolution of the index plate. The object of this is to prevent mistakes; but since the gears must be selected and a change made for every different number that is to be indexed, it would certainly be better for the use of American mechanics that the risk of an occasional mistake in indexing should be incurred, rather than that time should be spent in changing gears. There is the same kind of an indexing arrangement for moving the feed screw of the platen; this being for use in cutting racks, for which purpose there is also a special attachment.

The platen can be moved from either end by hand, and the cranks for lateral movement of the saddle on the bed and for vertical movement of the spindle saddle are at

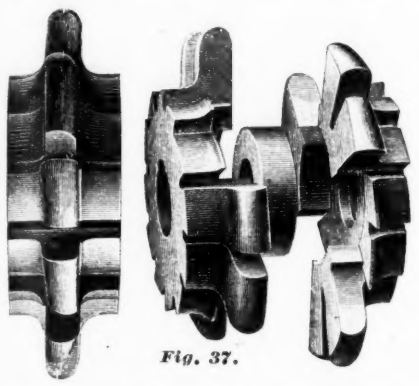


Fig. 37.

the right of the machine; all these movements being provided with micrometer graduations having a value of $\frac{1}{100}$ millimeter.

The thrust bearing of the spindle is a ball-bearing, and the spindle with its driving mechanism looks exceedingly light and weak for the rest of the machine, though perhaps its builders would prefer to say the same thing in another way; *i. e.*, that the rest of the machine is exceptionally heavy and strong for the cuts designed to be taken.

A small lathe is shown which is designed especially for threading taps from the smallest up to about ½ inch diameter. An end view of the bed of this lathe is about as shown in Fig. 39, the lead screw being at *a*, and the carriage fitted over the two dovetails, one on top of the bed and the other in front of it. The nut does not open and is permanently attached to the carriage, the hand movement of the latter when necessary being by turning the lead screw by means of a hand-wheel at its lower end. The cone pulley is loose on the spindle and drives by means of a friction clutch which is thrown in by hand, but is released automatically by the carriage as the tool reaches the end of

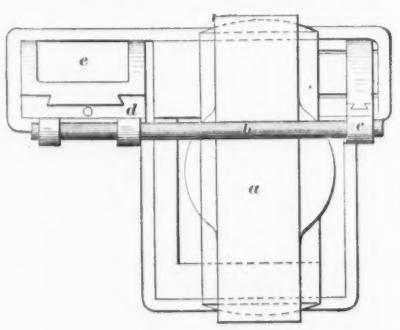


Fig. 38

the cut. The workman then presses down upon the lever *b*, which passes through the bed and is pivoted at the rear; from which two arms extend upwards and carry between them, mounted upon a spindle, the friction wheel *c*, which is driven in the manner indicated by a separate belt from the counter-shaft. Ordinarily this wheel *c* is thrown back out of contact with the small friction wheel *d*, which is on the spindle, but by depressing the lever *b* it is brought into contact, and very rapidly runs the lathe back to the beginning of the cut. In the small T slot at the back of the bed are placed the adjustable devices by which the tool is automatically moved away from the work at the end of the cut and restored to its place at the beginning of it; the first of these operations being accomplished by a device similar to that of our Slate taper attachment, except that the connection evidently acts by a spring catch which

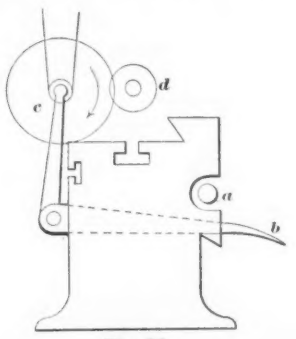


Fig. 39

holds the tool back when, by the reverse movement of the carriage, the sliding block is restored to its place; another tripping device releasing this catch and allowing the tool to come up to the work at the beginning of the cut. Micrometer graduations on the screws enable the tool to be fed in for the cuts, or to be moved in a direction parallel to the work as may be desired, independent of the other motions given to it.

A curious device is used on this machine, and one or two others, for setting the foot stock over. It consists of the key or feather, Fig. 40. The lower portion of this fits into the upper portion of the T-slot in the bed, while the upper dovetailed portion fits into a corresponding groove in the bottom of the foot-stock; this dovetailed portion, instead of being parallel with the other, being at an angle as shown, with the screw *a* for adjusting it lengthwise; this screw being fast in the foot-stock. It is

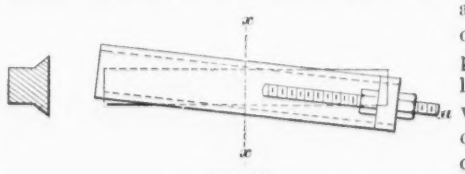


Fig. 40

evident that by turning the nuts on this screw the foot-stock is moved to the front or back as the case may be. A section of the key at *x*, in the middle of its length, is as shown at the left.

This concern pays some attention to the matter of standard gauges and has a measuring machine on exhibition; an idea of this machine being obtainable from Fig. 41. The large wheel at the right is on a micrometer screw, and has graduations on its periphery which are read by a vernier scale. The other head is moved by means of the screw and hand-wheel seen at the left, and carries a plunger between the point of which and that of the micrometer screw the measuring is done. The plunger in the movable head is pressed forward by a spring, but when work is to be measured the micrometer wheel is turned after contact is made until this plunger is forced back against a stud or projection which is in the center of a thin diaphragm, this diaphragm covering a cylinder about four inches diameter, within which water is placed. At the top of this cylinder there is an opening in which is placed a small glass tube similar to that of a thermometer tube but open at the top. The hole through this tube is so small compared with the diameter of the cylinder that when the diaphragm is forced back a very small distance the water in the tube is given a very considerable movement, and by taking all readings of the graduated wheel when the water stands at the same height in this tube it is assumed that the contacts will be the same. A card on the glass case within which this machine is kept states that it is accurate to .0001 mm. or $\frac{1}{250,000}$ inch, which in the decimal form would read .0000004 inch, or four millionths of an inch. I confess I should have a good deal more confidence in the reasonable accuracy of the machine if the claim for it were very much less. What I suppose the makers really mean is that the machine will indicate variations of magnitude of the value named, which is a very different thing. They, however, guarantee its accuracy to twice the error given, which beats the best American guarantee more than twice over, though from what I know of American measuring machines I feel very confident that the best of them are much more accurate than this machine, and I think very few who are familiar with the difficulties encountered in measuring such magnitudes as those named above will be ready to believe that a machine constructed as this one is can possibly reproduce measurements within such a limit of variation as that named.

The workmanship upon the tools shown in this exhibit is of a high order, so far as can be judged from such an examination as can be given by merely looking at the machines. Hardened and ground steel spindles are used, with bronze boxes tapered outside and with provision for taking up wear. Case hardened parts are freely used, as are also scraped surfaces.

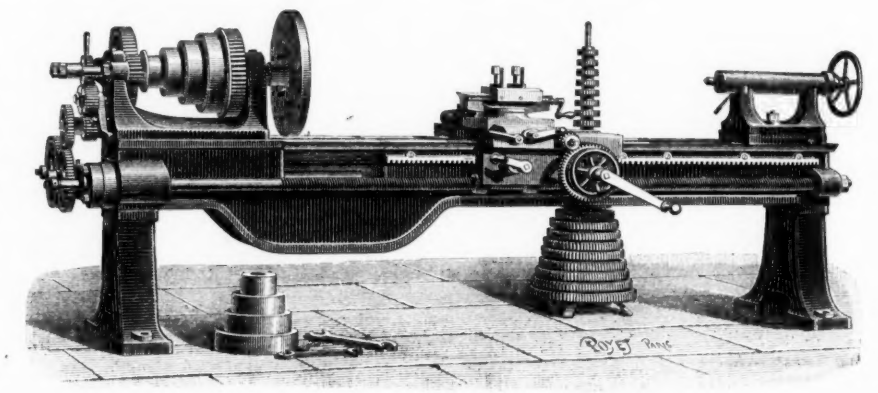


Fig. 42.

The tools are very creditable, but are largely American in design and style of finish. Indeed the catalogue of the makers shows that they build machines (not shown here) that are exact reproductions of well-known American designs.

FRENCH MACHINE TOOLS.

There is but one exhibit of machine tools from France, that of the Société Dandoy-Mailliard, Lucq & Cie., Maubeuge, and it may be that French machinists can do very well with such tools as these are. If they can they are entitled to a very great deal of credit, I am sure; but I am equally sure that an American machine shop equipped with such an outfit and attempting to build machinery that met the competition of other shops would go into bankruptcy in less than six months. They are quite original, however, though a little on the English order. At Fig. 42 is a reproduction of a French woodcut of the largest lathe in the exhibit. It is what we would call a 24-inch lathe. The end thrust of the spindle is taken on the point of a conical pointed set-screw which passes through the yoke at the back of the spindle, presenting a bearing surface for this which can by no possibility wear well if the lathe were to be crowded at all, though it would probably stand all the strain that ought to be imposed upon the rear upright of the head-stock. Notice that the face plate is a solid, plain plate as heavy as it can be made for its strength (or as weak for its weight), and has holes so arranged that if the workman wants to move a bolt in any direction he must take it out of the hole it is in and then take his choice between the others. All their lathes are provided with the inevitable English gap, which increases the swing of the lathe for an occasional job and very materially reduces its efficiency for every other one, the balance being undoubtedly very much

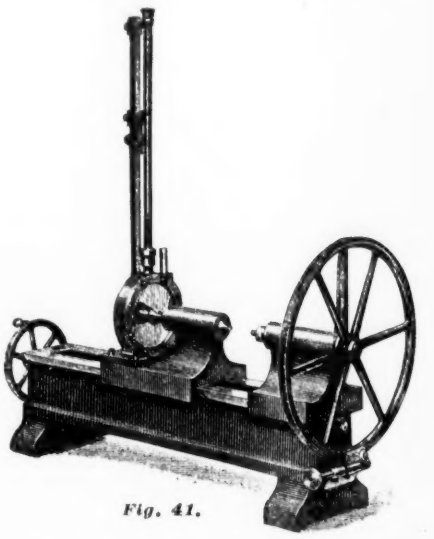


Fig. 41.

against it. There is no such carriage movement as an American considers essential, the long crank at the right of the carriage being on the end of the shaft which carries the rack pinion at its other end, there being no intermediate gearing; the result of which is that this heavy carriage moves 6 inches for every turn of the crank, *i. e.*, it moves, provided the workman has the necessary strength to move it, the crank being made as long as the surrounding space will permit in order to help him out as much as possible. The carriage moves to the right when the crank is turned to the left. Of course the Frenchmen use the upper slide a good deal for such movements of the tool as we would make by moving the whole carriage; but when this is set for turning or boring a taper, the carriage must be moved to give longitudinal movement. This particular lathe, having all the latest improvements, has an automatic feed for the carriage independent of the lead screw, and this is effected by going to the back of the lathe with the feed rod which is driven by an extra set of gears shown in place in the engraving. This feed rod is splined and provided with a worm which drives a worm-wheel that is on the other end of the shaft which carries the pinion seen on the front of the carriage. This pinion drives the previously mentioned crank-rack pinion shaft, through the medium of the larger spur gear which is loose on this shaft, but can be made tight upon it by running the hand-wheel up against it, this hand-wheel being threaded upon the

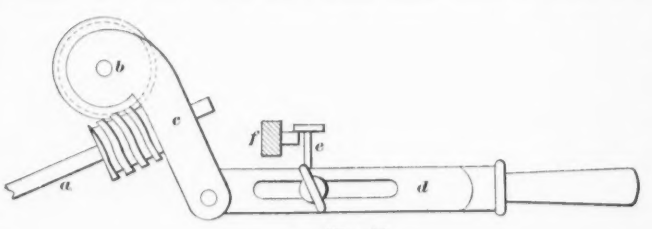


Fig. 43

shaft for that purpose. The lead screw is placed about as far as it can be got away from the work without being in the way of the lathesman, in order not to interfere with the occasional job that is to be swung in the gap and the carriage is made lop sided for the same reason. I did not measure the angle of the centers, but should judge them to be at least 90°—possibly they are more.

The sketch, Fig. 43, will serve to show how handy the French tool builders are in the habit of making things for the workman. This is the feed tripping device of a milling machine, *a* being the feed shaft, which is driven by universal couplings from the back of the machine. The feed screw is at *b*, and there is on this a small worm-

wheel with which the worm can be engaged. This worm is on the feed shaft, as shown, the end of which is supported in a bearing held in some mysterious way between two thin plates, one of these plates being each side of the worm-wheel and fitting over the feed screw. Between the lower ends of these plates is fixed the end of the lever *d*, and this lever has at its inner end a cam which raises the worm into engagement with the wheel when the lever is raised, and *vice versa*. In this lever is a slot in which there is a block that can be secured in any desired position by the thumb-screw, and this block carries the small pin *e*, while *f* is a section of the shifting rod which the dog comes into contact with to detach the feed, this rod having upon it the small lug as shown. Now when the feed is to be thrown in the workman gathers up the lever *d*, raises it, and adjusts the head of the small pin upon the lug as shown. Then when the carriage has fed far enough to move the rod *f* so much that the pin can no longer hang on, the whole thing falls to pieces apparently, and must be gathered up again when the feed is again wanted. There is absolutely nothing to keep these various devices in place laterally, except the fit of the various joints, and any one familiar with such matters may easily judge about how definitely the point of disengagement is fixed. When the saddle is moved in or out upon the knee the pin *e* must be readjusted by the thumb-nut.

The planers shown are fairly well designed tools, though there are too many gears on the outside of the bed and overhanging the bearings of the shafts on which they are placed.

Slotting machines are about as we build them here, but have no quick return motion for the bar.

Their twist drills are all what we would call left-handed; a curious circumstance in view of the fact that their lathe heads are arranged the same as ours, and the spindles turn in the same direction. I had always supposed that the direction of rotation of our drills was fixed by their early use in lathes, and it seems somewhat strange that the same influence should not have produced the same result in France. The workmanship on these tools cannot be said to be of a very high grade, and in the little points which go to make up what we call handiness they are sadly deficient.

Jackson Park, July 10. F. J. M.

Flat Veneer Cutter or Slicer.

With this we give a perspective view of the upper section of a flat veneer cutter or slicer; we also give outline drawings showing the general arrangement of the gears, which are hid by the floor shown in the perspective view. In the latter view, the knife bed with its cap are seen towards the left, and the framing with the inclined guides for the cast-iron stay-log are seen towards the right.

The knife bed is of an improved construction; its ends, which rest on the guides of the main bed, are cast separate; two views of these ends or heads are shown in Fig. 1. They are bolted to the knife bed by screw bolts, as shown, and sufficient clearance is given to allow the knife bed to be tilted, by which the edge of the knife may be thrown forward or backward at will to suit the different kinds of woods from which the veneer is to be cut, without interfering with the larger adjusting screws shown at the extremities of these heads. By these means the necessity of tilting the knife bed on the carrying blocks is obviated, and safety and ease in operating, without any jar or tremble, is secured.

For feeding the knife up to the log, two feed screws are used, one at each end of the bed (one of these is shown in the front of the perspective view). These screws are worked by hand; the feed is not automatic. The feed screw nuts are adjustable, to take up wear.

The face of the stay-log is plainly shown at *A* in Fig. 2. To its rear side, carriages are bolted which move on the inclined guides *B*, *B*, *B*, giving the stay-log and the wood which is fastened to it by adjustable clamps, shown in the perspective view, a lateral motion during the up and down strokes, the knife in this machine being stationary during cutting. Motion is transmitted to the stay-log from the gearing below. The spur wheel *C* and the crank *D* make a complete revolution. The rod *E* connects the cranks *D* and *F*, the latter making a part of a revolution only. The spur wheel *G* keyed to the same shaft with the crank *F* transmits motion to the gears *H H*, and their cranks *I I*, which also make a part of a revolution only, and the connecting rods *K K* give the desired motion to the stay-log *A*. It is claimed, that with this arrangement the thrust on the inclined guides and their wear are reduced to a minimum, heating of the guides is avoided, and a steady and even draw obtained.

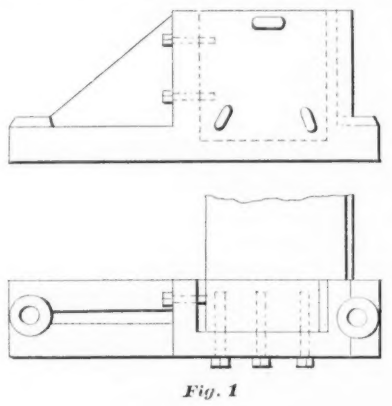


Fig. 1

Fig. 3 shows a plan of the gearing, shafts and bearing.

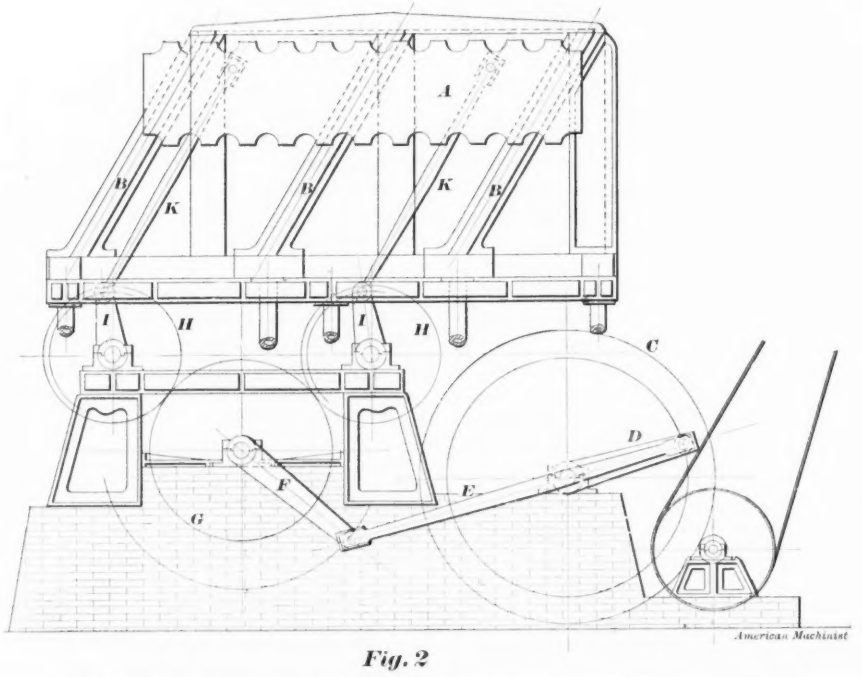


Fig. 2

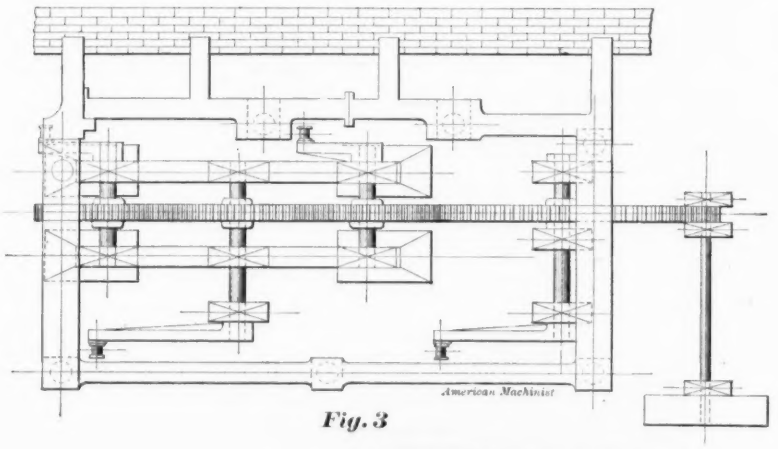
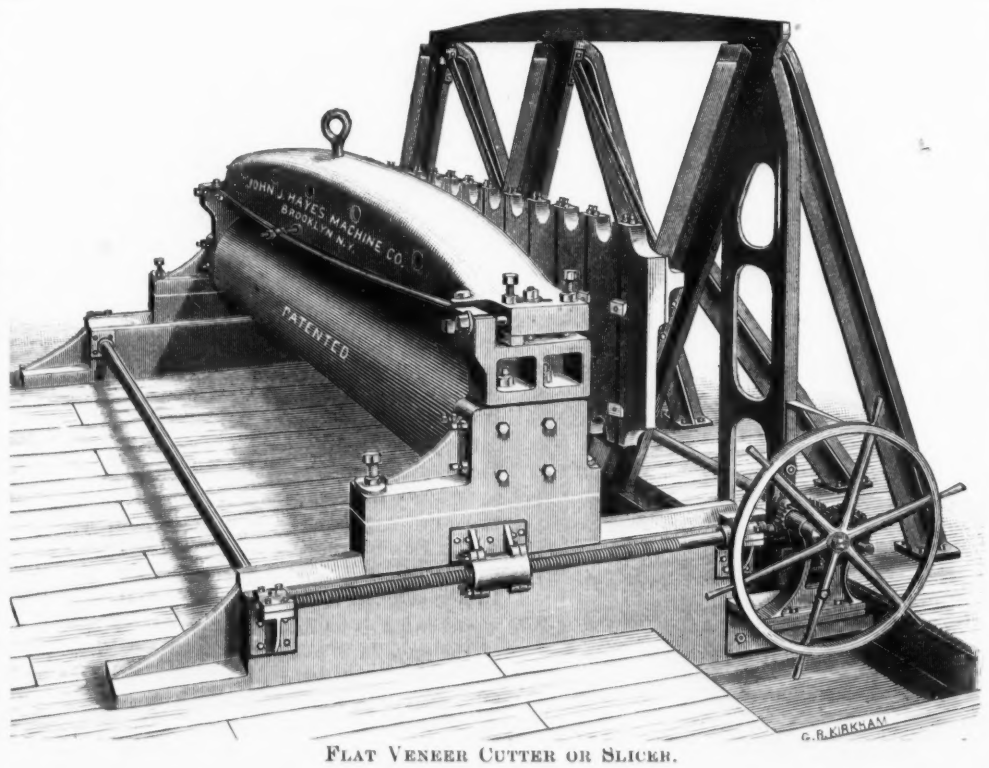


Fig. 3



FLAT VENEER CUTTER OR SLICER.

The machine complete weighs about 27 tons. It is driven by an 8-inch double belt on a 48-inch pulley. The machine can cut veneers from a log 12 feet long by 30 inches wide at a rate of 20 veneers per minute. These machines are built by The John J. Hayes Machine Co., 108 to 118 West street, Greenpoint, Brooklyn, N. Y.

A Shallow Draught Steamer.

The Engineer (London) has this in the way of description of a shallow draught steamer built by Messrs. Yarrow & Co. . . .

"We have now to deal with an entirely different type of light-draught steamer, viz., a boat propelled by a single screw 45 feet in length by 7 feet beam, yet not drawing more than 12 inches of water. The bottom of the hull is perfectly flat, and the bow spoon shaped. Steam is generated in a horizontal boiler, and the engine is of the simple high-pressure inverted type, driving a screw about 2 feet in diameter. To immerse this size of screw in a boat of the usual form would necessitate a draught aft of at least 2 feet, but in the class of vessel we have before us the water is sucked up, as it were, into a raised tunnel built into the bottom of the boat, and the propeller revolves in it, and is consequently not only entirely immersed, but also well protected from injury.

"As before stated, the extreme draught is only 12 inches, owing to this method of drawing up the water to feed the propeller, which is a system not sufficiently well known, but nevertheless which has been adopted in few instances for many years past. When building the first steamers on this principle, special arrangements were made for keeping the tunnel full of water by exhausting the air out of the upper, or above water, part of it. Experience, however, has shown that the action of the propeller itself is quite sufficient to draw up the water and drive the air out at the after end of the tunnel. On trial in the Thames, a speed of seven to eight miles an hour was easily maintained, and the towing power of the boat was excellent. This little vessel is capable of seating comfortably about thirty-five passengers, but it is mainly intended for towing small native barges. There is a wooden awning extending the whole length to serve as a protection against sun and rain. The steering wheel is forward as usual in vessels for tortuous rivers where a good lookout for snags, etc., is of the utmost importance. The hull is constructed of galvanized steel, which is the most durable material for African river steamers."

Aerial Navigation Congress.

Among the various congresses to be held at Chicago this summer, there will be a conference on aerial navigation, August 1 to 3. The local committee is composed of engineers and university professors, who have made an effort to elicit papers and discussions from capable scientific writers and experimenters throughout the world. The secretary, Prof. A. F. Zahm, of Notre Dame, Ind., has received valuable papers describing the recent experiments of inventors in this and the European countries—England, Algeria, and Australia. Among the contributions are photographs and descriptions of several successful steam flying machines, and of the great military balloons of twelve different nations. The published proceedings will doubtless be of interest to students who wish to learn what is doing in this field of research.

It is said that the Manhattan Beach Railroad Company, on which the shocking accident recently occurred at Parkville, keeps a watchman at an important junction station on duty, once at least in each week, twenty-four hours continuously. If that is the fact it is no wonder that the watchmen sometimes go to sleep, that switches are not properly attended to and that trains are wrecked. It is unbusinesslike, inhuman and reckless.—Jersey City *Evening Journal*.

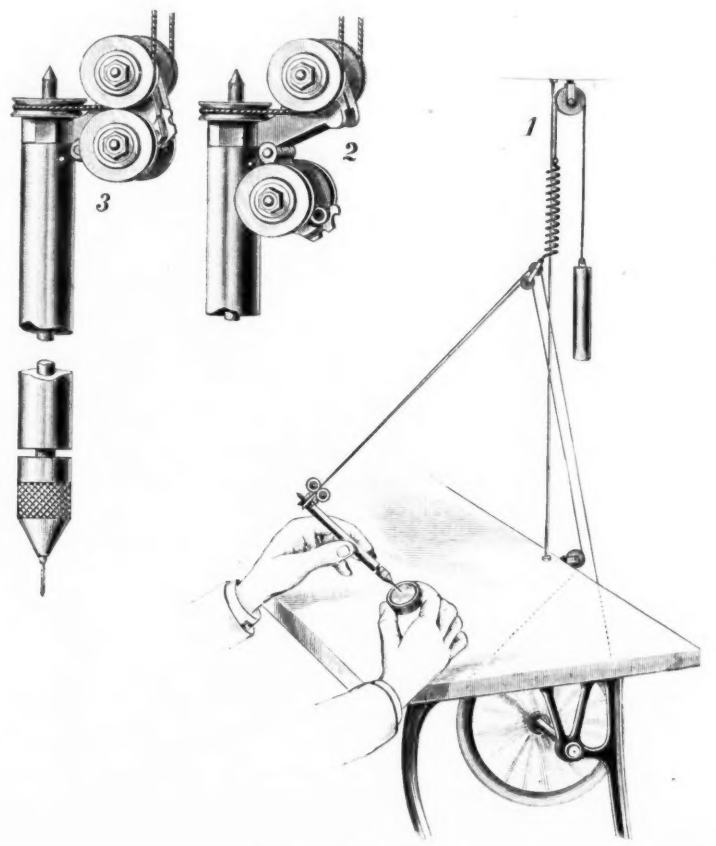
A New Hand Drill.

With this we give illustrations of a new hand drill and the mechanism for driving it. It is designed for the use of jewelers and dentists, and is also well adapted for ordinary light work in metal, wood, glass, etc.; or replacing the drill by a suitable polishing wheel, the instrument can be used to advantage for polishing stone, and for many other purposes of similar character. It may be driven at a high speed, and at the same time be conveniently held at work on top, bottom or sides of objects.

The construction of the drill holder is exceedingly simple; the drill is held by a chuck attached to the lower end of the spindle, which revolves in a small cylindrical casing, as shown in Fig. 3; to the upper end of this spindle a grooved pulley is fastened, and near this, two pairs of pulleys of similar form are supported by a bracket on the casing; the lower pair are hinged, as shown in Fig. 2, for convenience of passing the driving cord around the pulleys.

Fig. 1 shows the mechanism for driving the drill. A driving pulley, to which motion is transmitted by means of a treadle or in some other approved manner, is journaled beneath the work-table, and to the outer edge of the latter is attached an idler or guide pulley; above this, a small frame carrying two pulleys is supported by the lower end of a helical spring whose upper end is held by a cord which passes over a pulley fastened to the ceiling; to the other end of this cord a weight is attached for the purpose of giving a desired and constant amount of tension in the driving cord, without any regard to the position in which the drill may be held. The driving cord is endless and passes over the lower pulley in the suspended frame, from thence it engages with one of the pairs of pulleys held by the bracket on the drill casing and the pulley on the drill spindle, as shown in Fig. 3; then it passes over the upper pulley in the suspended frame, and finally passes downward over the driving pulley and then upward in contact with the idler. A guide rod extends from the ceiling to the table, passing through the inside of the helical spring so as to keep the pulleys in the suspended frame in proper alignment with the driving pulley. With this arrangement the drill can be moved into any position on the work-table without interfering with its operation; or the device can be readily changed into a light emery-wheel grinder or polishing machine—in fact, it can be used for a comparatively wide range of purposes.

This device is patented by J. W. Knapp, Cross River, N. Y.



A NEW HAND DRILL.

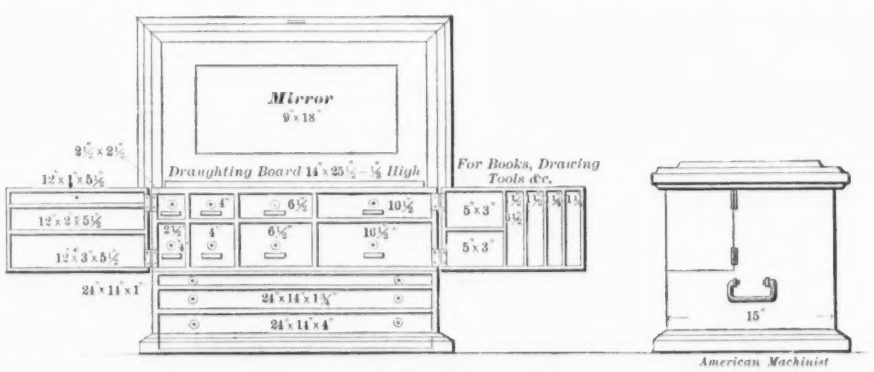
LETTERS FROM PRACTICAL MEN.

A Tool-box.

Editor American Machinist:

There has been growing daily a fancy and desire amongst machinists for a better class of tools, and in the course of events the machinist, with a fine lot of tools, feels the need of a good box to keep them in. There is, to a certain degree, an elevating tendency in the possession of an equipment of fine tools, or of tools finely kept, and the tendency is still further enhanced by the possession of a good box for good tools. The machinist should take, and probably does take, the same pride in his good box of good tools, well kept, that the machine shop owner does in his shop of good machinery. Believing that the tool-box question is not exhausted, I send you herewith a print of my box. The material, and degree of finish, and other details are left to the desire, fancy, and pocket-book of the owner thereof. I have provided this box with twelve compartments, as shown, in the center of the body of the box. I have these made of heavy green pasteboard, similar to lawyers' and book-keepers' desks, for both lightness and also so as to be lined inside with felt cloth to protect the fine tools. Suitable places for labels are provided, as shown. The three drawers to the left are for such tools as are too long for the pigeon-holes in the body of the box. To the right I provide places for books. This I regard as most important, and many hours while running a machine a man has chance and time to improve himself. I have two places for drawing tools in the right-hand compartment. In the bottom part of the box I have drawers, full length and full depth of box, as shown, for 24″ scales and straight-edges and levels and what not. I have provided at the top a drawing board 14x25½x½″; this is of soft wood, screwed on, and can be renewed often, and can be squared up when out, etc. I show a mirror which, aside from the general good effect produced, has certain qualities of causing a man to tidy up and keep looking as cleanly as his vocation will admit. With handles to carry by and recessed lid that closes over the whole box when closed, it becomes solid, and will bear shipping easily. Make the outside structure of hard wood and soft wood inside. As to the cost, many will raise this question, but a man who can buy good tools can buy such a box, and it will be money well invested. I submit this for the trade, and hope it will meet the wants of some of "my brethren"

C. A. BURTON.



A TOOL BOX.

Motors on the Intramural Railway.

Editor American Machinist:

In your issue of July 13th you state that the motors used on the Intramural Railway of Chicago are known as the L. W. P.—20–25—interpreted, 20 pounds horizontal effort at 25 miles an hour.

You will remember that at the last meeting of the Street Railway Convention held in Cleveland, it was decided that the rating should be in hundreds of pounds horizontal effort. Consequently, L. W. P.—20 indicates 20 hundreds of pounds, or 2,000 pounds. This, you will see, explains the discrepancy which you indicate in your paper.

Will you kindly insert a note giving this information, in order that an apparent discrepancy may not be afloat with reference to this apparatus? JOHN B. BLOOD,

Asst. Engr., Ry. Dept. General Electric Company.

The Expected or the Unexpected.

Editor American Machinist:

No subject can be rightly understood unless two or more views be taken of it, and conclusions can never hope to be solid and true without going through the why and wherefore mill.

Criticism is therefore one of the best sieves to separate the real from the unreal—the right from the wrong. For this reason I thank Mr. Martin for his friendly criticism which appeared in your issue July 6.

In replying, let me correct the impression which my composition seems to have made. Mr. Martin says that my article ended by calling it the "unexpected," and further on the article should be entitled the "expected." Upon reading that statement I felt something like the person who was asked to play "Home, Sweet Home" just after having rendered it. I meant to show that the cracking of the drum caused by carelessly allowing such a fin to get around the print could *not* be fairly called the unexpected but the expected, so that Mr. Martin's intended opposition on that point is lost, leaving no room for argument, because he unknowingly agrees with me. Let me ask Mr. Martin to read my communication in your issue of June 22 again, from where it begins "can the foregoing, etc.," without disconnection, when I have no doubt he will see the point.

Now as to the cause of the shrink cracks in question. Mr. Martin says "the core ring was the prime cause." In this we disagree.

Let us, for example, discard this core ring for the time, substituting nothing but bricks and loam and see what would happen with the same fin formed around the print part. Would not that fin cause shrink cracks in much the same manner? I think it would. Why? Because on such a large circle the metal that makes the fin is cooling and shrinking before the metal in the flange and outside of drum is quite set, or has begun to shrink, thus subjecting the latter to the pulling strain of the shrinking fin, and causing cracks as before when core ring was used. The drum shown in the AMERICAN MACHINIST June 22 was not represented in halves; but I think that is understood.

If your correspondent could have seen the drum I referred to, when it was pulled out of the pit, with such a fin on the two halves as I have described, he could have readily seen that it was "the fin that broke the drum," and also that such a fin was produced through carelessness and should not have been there with or without the core ring.

I believe there are very many queer things which happen to castings through fins being allowed to form on them. Sometimes it is the fault of the patternmaker, and at others the molder. I am reminded of one instance where it was the molder's. Some 8 foot crank disks were cast; the section of rim was of the ordinary type. On the outside cracks appeared. Such cracks I know are too often caused by the counterbalance on the disk, but in some cases they showed up away from the counterbalance, in which case it could not be owing to the extra metal in counterbalance, so I asked the foreman who is a man of recognized ability, if he could not prevent such a thing, as it looked bad. He said, "Yes, it is —— carelessness on the part of the molder," intimating at the same time that the molder sleeked the edge of his mold down too much to prevent crushing when closing it, so that the iron ran between the joint, causing a fin which pulled the rim off the disk. I mention this because it seems to me to have some relation to the question under discussion.

The suggestion which Mr. Martin offers as to another and better way of making these drums is good, because most molders prefer to drop the outside over the inside of nearly any kind of mold, but it is a question whether it is better to sweep up the groove part of drums measuring 10 and 12 feet in diameter by 72″ face in a pit and dry them in place without handling, or whether it be better to put them in the oven after sweeping. If the former plan be adopted, then the core must be lowered in, as in the case of the ones I have written about, but if the latter, then it is better to drop the outside over the center part.

Now as to making the drum with the outside flange down, as proposed by Mr. Martin. I would say that there is no machine work done on this flange which he proposes to cast down, while the other that is shown down in my sketch is turned and drilled.

In the matter of "lifting off the outside" and "lifting out the core," I must inform your correspondent that no such process is resorted to, each part being built independently of the other—he must be thinking about ramming up a cheek and lifting it off or lifting out the core on an anchor plate, but it would not be "good practice" for 10-foot drums. P. S. DINGEY.

Chicago, Ill.

An Error in Speed Variation.

Editor American Machinist:

Regarding E. J. F.'s letter on "An Error in Speed Variation," I would say that the gentleman is both right and wrong. He is right in calling attention to the obvious slip I made in stating that the speed variation would be double with both pulleys variable, but he is surely in error in stating that the per cent. variation in the example for two pulleys is $(138.22)^2 - 1$. This would give 38.22 per cent. variation with one, and *19,103.7 per cent.* variation with two variable pulleys—a result which is manifestly absurd.

If we have two pulleys, one of which is increased in diameter from 1.00 to 1.3822, while the other is decreased from 1.3822 to

1.00, it seems clear that the ratio of maximum to minimum speeds will be $\frac{1.3822}{.7234} = 1.91$, so that the total variation will be 91 per cent. instead of 76.4 per cent., as given in my contribution. This, as will be seen, does not materially affect the question at issue, my contention being that the Gordon variable speed arrangement does not give a larger variation of speed than can be obtained by ordinary cone-driving gear. Doubtless E. J. F. was induced to take so greatly an exaggerated case as he has, because he found his correction had so little influence on the result; but he has certainly bettered the instruction he professes to have received from my example of the indicator gear. In that case, however, I used proportions about double of those likely to obtain in practice, with the object of making the drawing as clear as possible. But this does not give E. J. F. license to take an example with a variation eight times as large as the Gordon pulley, with an extreme angle, will allow, and possibly twenty times as large as will be found permissible in practice. M. E.

Horse-power and Strength of Gear Teeth.

Editor American Machinist:

After reading the letter from Mr. Lewis in the AMERICAN MACHINIST on the above, I felt it necessary to add something to what I have written on the subject. The article I wrote was mailed to the editor on April 25th, and therefore before the appearance of the paper from Mr. Lewis, and had I known what Mr. Lewis had done on the subject I would not have sent the article until I had seen his paper. I appreciate that his work in that direction has been much more thorough, perhaps, than mine, and I will say further that a remark of his that "he did not think that the question of the strength of gear teeth was an insoluble snarl," was what first led me to attempt to deal more accurately with the question, and for some time I have discarded the use of all general rules, and instead have figured the strength of wheels from the actual size of the tooth in question, considered as a loaded beam. I am quite content, therefore, if my effort to construct a general rule has incited Mr. Lewis to evolve a more accurate one. It will be appropriate to mention here that Joshua Rose in his "Modern Machine Shop Practice" points out that to calculate correctly the strength of a gear tooth, a parabolic curve should be applied to it to find the weakest section of its shape, and he gives a drawing showing the parabolic lines as they appear in reference to a tooth curve. He goes no further with it than that, but it is the only place I have seen it mentioned or applied to gear teeth until Mr. Lewis made use of it. Of course that was a quite obvious thing to do, but the fact remains that of all those who have prepared rules for engineers to use in calculating strength of gear teeth, no one has taken advantage of it.

Mr. Lewis thinks that "the ultimate strength fails to proclaim itself" in the formulas I gave, but I think he must have given them a hasty inspection or he would not have said that. The formulas are:

No. 1. H. P. $= \dfrac{p\,v\,f\,(n-2)\,.33}{s}$

No. 2. H. P. $= \dfrac{p\,v\,f\,(n+340)\,.0205}{s}$

To find the ultimate strength of a tooth it is very plain to be seen that it may be done by using 1 for s, or omit s entirely; then take $v = 1$ foot per second, and as the velocity is in feet per second 550 pounds will be the strain per horse-power, and that is what it takes to break the tooth figured on.

I find on comparing with the formula of Mr. Lewis that it gives a much lower value than my calculations do. Taking 25,000 as the ultimate tensile strength of cast-iron (and it takes good iron to stand that), his formula, taking $p = 1$, $f = 2\frac{1}{2}$, $n = 20$, and y from the table $= .09$, gives $W = 5{,}625$ pounds. My calculations for the same sized tooth and with 7,500 pounds as the breaking strength of a cast-iron beam 1″ square, 1″ long loaded at the end gives 8,850 pounds. I find that this difference is caused by the ratio of tensile to transverse strength used by Mr. Lewis in working out the formula, and was $W = \frac{s\,f\,t^2}{6\,l}$. D. K. Clark in "The Mechanical Engineer's Pocket Book," page 322, points out that this is not correct, and gives $W = \frac{s\,f\,t^2}{3.43\,l}$ as the correct formula. I do not know how Mr. Clark determined it, but it certainly accords more closely with experiments on the transverse and tensile strength of cast-iron than the first one does. For example by the first formula cast iron with a transverse strength of 7,500 would require to have 45,000 tensile strength; something I have not heard of being attained by anything but a specially fine mixture of iron remelted. By the second formula the tensile strength would require to be 25,725 pounds, and experiments have shown that iron of that tensile strength will have not far from 7,500 pounds transverse strength. Correcting by this formula for cycloid teeth the factor y for 20 teeth will be .157. Taking $p = 1$, $f = 2\frac{1}{2}$, $n = 20$, $s = 25\,725$ pounds, $y = .157$, we get $W = 10\,095$ pounds. With a 20-tooth wheel as I had the tooth designed and by my method of calculating $W = 8{,}850$ pounds as shown above. This difference is due, I think, mainly to the use of larger fillets, as Mr. Lewis has noted. Taking the improved general formula by Mr. Lewis, and adopting it to use the transverse strength for s and substituting my calculated factors for 12 teeth and a rack it becomes $W = s\,p\,f\left(.675 - \frac{5.25}{n}\right)$. Applying this to wheels of different numbers of teeth I find the following variation:

No. teeth.	Factor by formula.	Actual factor.	
12	.238	.24	....
14	.3	.26	.015
16	.347	.385	....
20	.413	.472	.0143
24	.457	.49	....
32	.511	.558	....
40	.543	.585	....
80	.62	.62	....
Rack	.675	.675	....

The column headed "Actual factor" was obtained by squaring the breadth of the base of the parabola on each tooth and dividing by the length to the point of the tooth. It is the value for one inch pitch teeth.

The constant in the formula is changed slightly, so the variation of the 14 and 20-teeth pinions will be about of equal percentage, and that is why it is not exactly correct for the 12 tooth pinion. A comparison of the factors for the 14-tooth pinion shows that the calculated factor is over 14 per cent. greater than the actual factor, while on the contrary for the 20-tooth pinion the actual factor is over 14 per cent. greater than the calculated factor.

This explains why I found it impossible to apply a formula that would be reasonably accurate, and was led to use two formulas.

By using fillets of as large a radius as possible on all pinions, Mr. Lewis avoided that difficulty, and there is no doubt that is the way they should be made, but it is seldom done on teeth of wheels cast from patterns, because it is more trouble to design teeth that way, and is also more trouble to the pattern maker. For these reasons nearly all the cast pinions in use are without fillets or have such small ones they are almost useless, and the possibility and value of large fillets is not appreciated.

Regarding the factor of safety and the elastic limit there is yet room for an honest difference of opinion on the subject. D. K. Clark says that "cast-iron in tension and compression does not exhibit a well defined elastic limit."

W. C. Unwin considers the elastic limit, but prefers to use the ultimate strength in calculations, after fixing the factor of safety so it is known to be below the minimum elastic limit. He gives the elastic strength of cast-iron at 10,500 pounds, which is about the same as given by Reuleaux. There is lack of reliable experiments on the elastic strength of materials, and until we know more on the subject we must rely on the ultimate strength and a factor of safety.

For a rule for general use in calculating strength of gearing it is convenient to have it in the form of a horse power equation, because it is so used in nearly all cases, for the simple reason that no more accurate statement of the strength required is available.

For general purposes I would therefore put the formula as follows:

(For standard cycloid gearing)

$$\text{H. P.} = \frac{v\,t\,p\,f\left(.675 - \frac{5.25}{n}\right)}{550}$$

Where t = transverse strength of material;
v = velocity at pitch line in feet per second;

t for cast-iron is 7,500 pounds ultimate, but the elastic limit might possibly be as low as one-third that. Steel would be $2\frac{1}{2}$ times stronger in ultimate strength with an elastic limit of about one-half the ultimate strength. This formula may be 14 per cent. inaccurate on pinions without fillets, but if greater accuracy is desired I do not see how it can be attained by one general formula, and where greater accuracy is required the tooth to be calculated should be laid off and have a parabola plotted on it. BELL CRANK.

Acknowledges the Correction.

Editor American Machinist:

I am glad to learn that I was off in my geography as to the works of Stumm being in Germany rather than in Austria. I only wish I could quarrel with your correspondent over the matter; in fact, if we could get up a good fight, it would be about the only fight I have heard of lately that promised much good. A fight always creates an interest, and if an interest could be created, I think more of the visitors would be likely to hunt up this exhibit of Stumm, and look twice before passing it by.

JOHN E. SWEET.

Objects to the Method of Finishing on Planer.

Editor American Machinist:

In your issue of 13th inst. I notice an illustration of a "Height Gauge" by C. A. Burton, which is at times a good tool no doubt; but I see nothing in the tool to warrant an operator in taking $\frac{1}{16}''$ finishing cut on a planer platen, for instance, or any piece of planer work requiring accuracy. He says: "A rough piece on a planer is to have a thickness of $1\frac{3}{16}''$; set the planer tool to the gauge at, say, $1\frac{7}{8}''$, rough it off, set down the tool to the finish of $1\frac{3}{16}''$ by the gauge, and you have the thickness correct at once." Great Cæsar! correct, after taking $\frac{1}{16}''$ finishing cut. What feed could he have used in that case? My experience is that $\frac{1}{64}''$ is too much, and half $\frac{1}{64}''$ is plenty to finish a piece of work with.

Again, if both sides of a piece are rough, and are required to be planed, then I should advise Mr. Burton to rough both sides before finishing either, as I fear, handy as the "height gauge" is, it would not prevent the piece from springing if finished by his method. HARRY M.

Some Large Siphons.

Editor American Machinist:

I have read with some interest the article by Mr. Joseph Torrey in June 15th AMERICAN MACHINIST, and will endeavor to help him some.

Now, to begin with, I want to say that the large siphons of which I write are of different proportions from Mr. Torrey's, and that may cause them to act better. Mr. Torrey's was a three-inch siphon 1,700 feet long with a head of 30 feet. He says that the pipe was well laid, but I think that there must have been a leak somewhere. The siphons that I wrote of range from 8 inches to 15 inches in diameter, and are used to siphon the water out of the Mississippi to flood the rice plantations along its banks.

As every one knows, the river is held within its banks by large levees, or, as I believe they are called in some places, "dikes." If we were to measure a levee we would find it about 14 feet crown or top, 75 feet at base and 12 feet altitude. It will be seen that our siphons are shorter and larger in diameter than Mr. Torrey's, also that they have less head, but they work well and steadily.

They start them the same way that Mr. Torrey's was started, viz., fit on a pitcher pump, plug up the land end of siphon, pump out the air, then let her go, and it will run providing the pipe is tight till the suction end, if I may call it such, is out of water.

I would like to ask Mr. Torrey (supposing him to be Professor Torrey and a theoretical man, which, I am sorry to say, I am not) if the extreme length compared with the small diameter of his siphon did not have something to do with his poor success. He speaks of experimenting with glass siphons. Suppose he enlarge their diameters so as to overcome friction and see how they work, and then let us know.

I may be wrong about this, but if I am I want to know it. ELI H. PEARCE.

Planing Machine for Forming Cycloidal Surfaces.

The engravings accompanying this article will serve to give an idea of the construction and method of operation of one of the most novel and original planing machines ever constructed. It is the invention of Mr. John F. Wilkin, of Connersville, Ind., and is designed for planing to shape what are known as "impellers," which are important parts of a new blower which is being made by the Connersville Blower Co., of which Mr. Wilkin is superintendent and engineer.

There are two of these impellers in each machine, and they are so formed that they may each be called cycloidal gears, having two teeth, the outlines of these impellers being shown at Fig. 2 page 7, the lower cut being the general perspective view of the machine as erected and set up for trial in the shops of Pedrick & Ayer, of Philadelphia, where it was built. In this an impeller is shown in position for being planed by the machine.

In order first to examine something of the theory upon which the machine is constructed, we refer to Fig. 2, wherein are shown two cycloidal revolvers or impellers in operative contact. In this figure, 1 designates the center of motion, and 2 is the pitch circle. Equal chords 4 4 are drawn within the pitch circle forming an exact square. This having been done it is only necessary to revolve a circle 3, which is one fourth the diameter of the pitch circle, over the pitch circle between the opposite angles formed by the chords beginning and ending exactly at said angles, and the lines scribed by the scribing point of the circle 3, which will be in its circumference, will form the opposite epicycloidal lobes. Now by arranging the same size circle inside the pitch circle and revolving from angle to angle of the opposite chords, as before described, the line scribed by the scribing point of the circle 3 will constitute the hypocycloidal curve.

Surfaces so formed when revolving together about the centers of motion 1, may be either always in contact or at a uniform and consequently very small distance apart, which is the object of the machine, *i. e.*, to produce impellers accurately planed to such shape that, when running together in a blower, there shall be at all times the smallest practicable space between the surfaces of the impellers, and thus the efficiency of the machine improved.

The detail engravings of the machine have been made from the patent office drawings and are not in all respects just as the machine was built, but serve very well to show the principle of its construction.

The general framework of the machine comprises a pair of opposite sides or standards 5 (Figs. 3 and 4), which are surrounded by a heavy flange, the whole being bolted securely to a base-plate. As each of these standards or sides is a counterpart of the other, a description of one will be sufficient for both. The standard is provided with a circular opening 8, Figs. 3 and 4, and above this is bored for the fixed stud 19, while vertically below opening 8 is a bearing 10. These three points are in the same vertical line, and are surrounded by a thick flange

as shown. The bearing 10 may be opened by the removal of the block 12, which is secured in place by the bolts indicated, thus providing a means of placing within and removing the work from the machine, as will be hereafter explained.

At the right of the standard, Fig. 4, is a horizontal arm in which are bearings for two spur gear wheels which are connected with the ring-gear 29 in opening 8 as indicated, the shaft on which the extreme right-hand gear of this train is mounted extending from one end of the machine to the other and by a similar train at each end, connecting the ring-gears, at either end with each other. It also carries a hand-wheel by which it may be rotated, and by means of which the ring-gears 29 are rotated from one position to another for the purpose to be hereafter explained.

Upon the fixed stud 19, Fig. 3, is placed the spur gear 25, which can revolve freely upon the stud and may occupy either one of two positions upon it, *i. e.*, it may be as shown at the right or it may be shoved to the left, half its face width against the fixed collar, and provision is made for engaging it in either position by means of the grooves cut in the stud as shown.

The ring-gear 29 is cut with teeth at the right of its face only as shown by its section, Fig. 3, and at the left is provided with a flange, as shown, which holds it in place within the standard. Within this gear is the eccentrically located opening 30, Fig. 4, at the lower side of which is a spring plunger which may engage with a recess formed in the shaft 36, this shaft being within a sleeve 33, which is rigidly fastened within the opening 30 and is provided at its left-hand extremity, Fig. 3, with a pinion 34, this pinion being of the same diameter as one (38) which is keyed to the right-hand extremity of the shaft 36.

The inner end of the shaft 36 is provided with a crank-arm 39, which carries a crank-pin 40, the radius of this crank-arm being the same as the pitch radius of the pinions 34 and 38. The shaft 36 has, in line with the crank-arm, a recess into which the spring plunger 30 *b* may engage when the shaft has made a half revolution from its position as shown in Fig. 3, in which position it should be said the lower tooth or space of the pinion 38 is exactly in line with the lower tooth or space of the gear 25, this being necessary from the fact that the gear 44, which is vertically below them, engages both.

Within the bearing 10 in the standard is fitted the sleeve 41, which is free to turn in the bearing, extends beyond the standard and is splined for the gear wheel 44, this gear wheel being movable laterally into or out of engagement with the pinion 38. The sleeve 41 is slightly tapered inside, and has within it a split taper bushing which is drawn into place by the threaded collar at the left, the bore of this split bushing being made to fit the shaft (84) on which the work to be planed is fitted.

At the right and near the floor line in Fig. 4 is a shaft, 58, upon which are fixed the spur gear 59, and the worm-wheel 60, Fig. 3, the latter being turned by a vertical shaft and hand-wheel. The gear 59 engages with the gear 44, and the shaft 58 runs through to the other end of the machine where it carries another wheel like 59, which drives the gear train at the other end of the machine. It will be obvious that with the parts in the position shown in Figs. 3 and 4, which is that for producing the epicycloidal curve, motion will be transmitted direct from gear 59 through gear 44 to pinion 38; but when the ring-gear 29 is turned through half a revolution and the pinion 38 is therefore in its lowest position it receives its motion through the gear 25, which is always in engagement with gear 44. This condition, which is that adapted for cutting the hypocycloidal curve, is shown in Figs. 5 and 6, in which it will be noticed that gear 44 is shifted to the right, gear 29 rotated through one-half revolution carrying the pinion 38 to its lowest position, while gear 25 is shifted to the left to engage with it. The indexing of ring-gear 29 for its two positions is secured by recesses formed in its face 180° apart, into which the spring plunger 87, Figs. 4 and 6, engages.

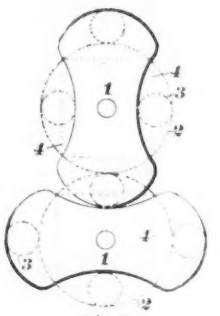


Fig. 2

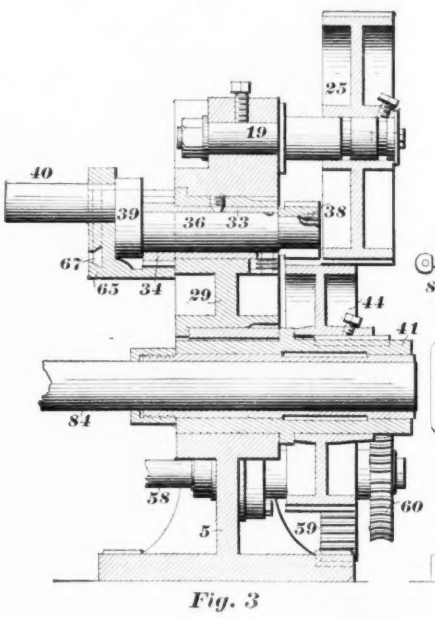


Fig. 3

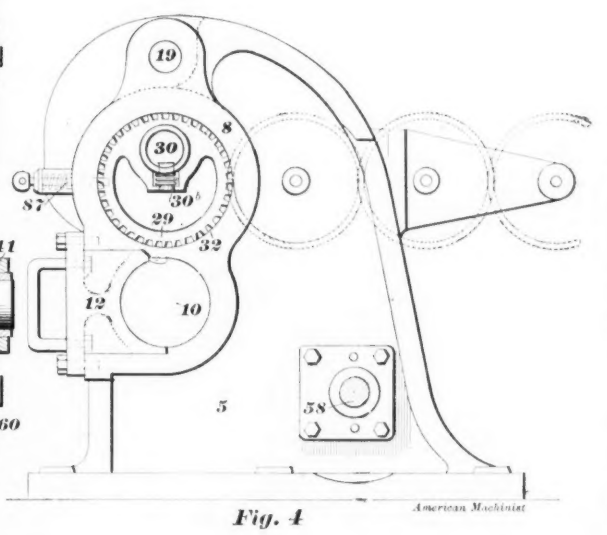


Fig. 4

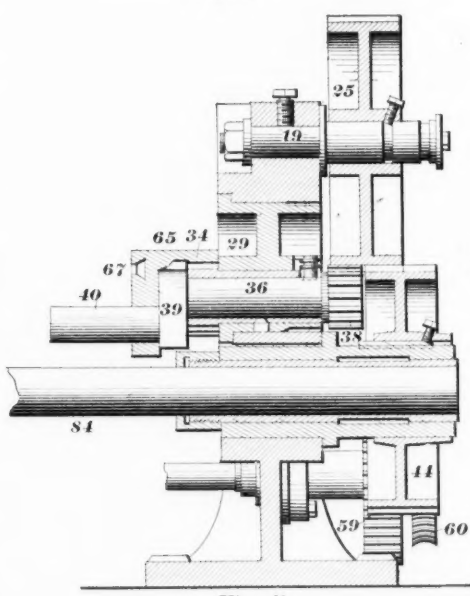


Fig. 5

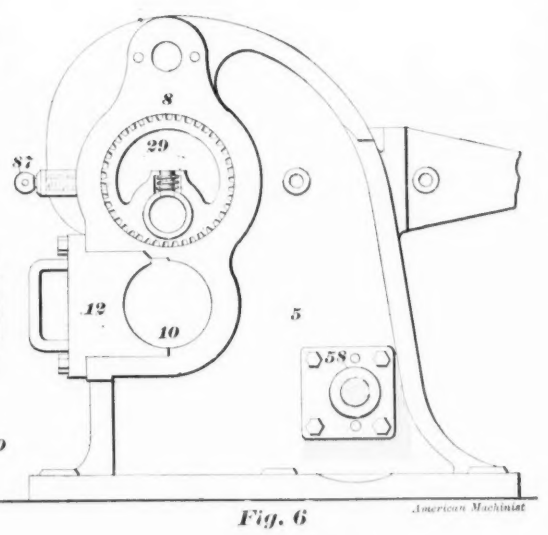
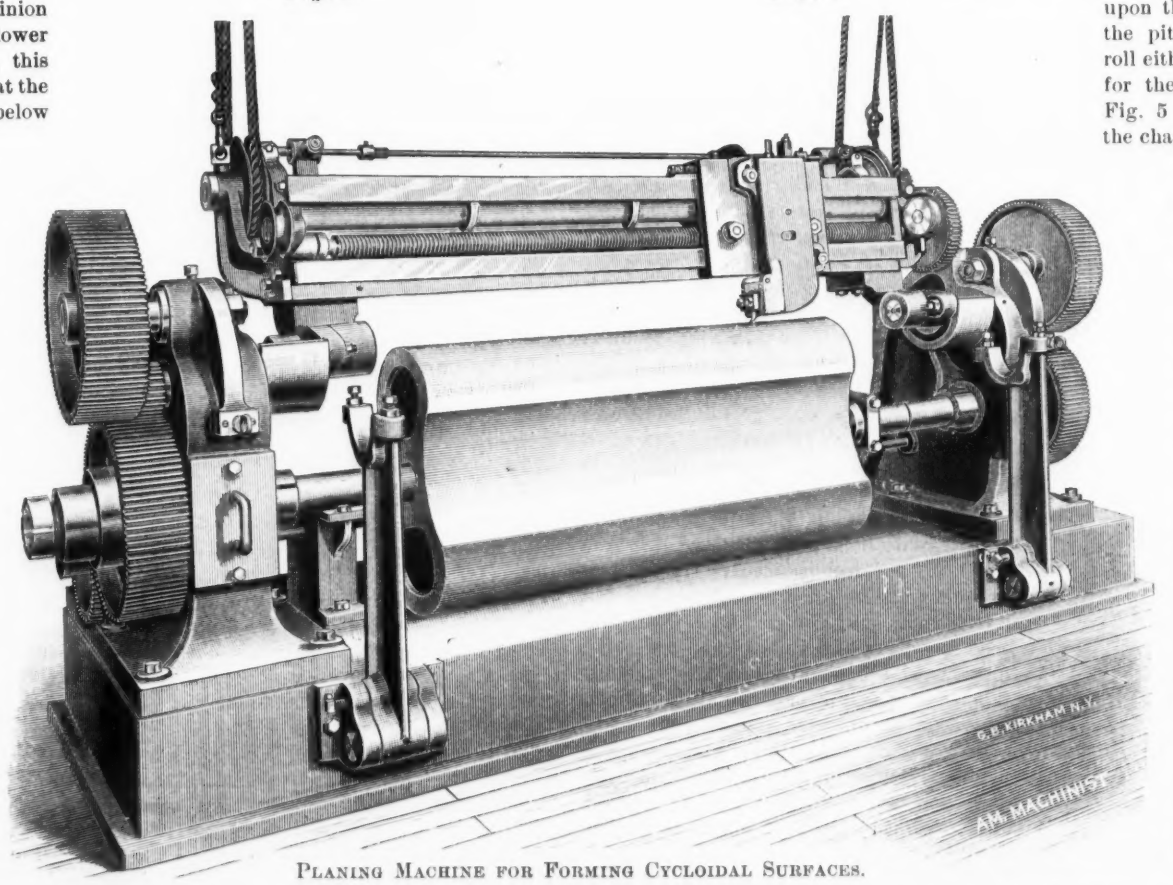


Fig. 6



PLANING MACHINE FOR FORMING CYCLOIDAL SURFACES.

Referring now again to Fig. 3, 65 is an internal, segmental gear which is twice the pitch diameter of the pinion 34 with which it engages; and its center being defined by the crank-pin 40, its point of engagement with the stationary pinion 34 is always diametrically opposite the crank-pin 40. The left-hand face of this segment has formed in it a dovetailed groove, 67, for bolts, by which arms that are journaled on the crank-pins 40 and support the slide or cross rail of the machine are secured, this being most clearly shown in the perspective engraving, where, as will be seen, the arrangement for guiding and driving the cutting tool is essentially that of the Richards' side planer as built by Pedrick & Ayer.

Above the machine is located an ordinary tension mechanism for driving the tool-carriage, so constructed as to permit of a swinging of the same.

In front of the machine and hinged to its base, as shown in the perspective engraving, are two standards having yokes at the top, and also screw-bolts which are adjusted to the proper height to receive and support the tool-slide or cross-rail while the machine is being changed from one curve to the other; the object of the swinging of these standards being to get them out of the way when work is to be put into or taken from the machine.

To introduce the work the hinged standards are swung to a horizontal position and the bearing blocks 12 withdrawn from the main standards. The sleeves, together with their bushings and the spur-gears 44, are then removed and the inner ends of the bushings slipped over the ends of the shaft, after which the parts are replaced, the blocks placed in position, and the split bushings tightened upon the shaft.

The work having been placed in position in the machine the cross-rail is brought down upon the screws in the top of the hinged standards before referred to, and the tool is then started, its cutting edge when taking the finishing cut being in line with the center of the crank-pin 40, which is in effect the tracing point in the rolling or generating circle 3, Fig. 2, the gear wheel 44 representing the pitch circle (2) in the same diagram. It will now be clear that as the work is turned by the revolution of gear 44, the cutting point of the tool which is the center line of the crank-pin 40, which is of the same radius as the pinions 34 and 38, will in effect roll upon this pitch circle represented by the pitch line of gear 44, and will roll either outside of this as in Fig. 3 for the epicycloidal, or inside as in Fig. 5 for the hypocycloidal curve, the changing points, or points where the two curves join, being defined by the stops before described, the changes indicated between Fig. 3 and Fig. 5 being then made.

It will be seen from the foregoing that Mr. Wilkin has succeeded in putting the pitch circle and the rolling or generating circle into material form in a way that is not only very ingenious and original, but also very useful for the purpose indicated, since it enables the impellers of a blower to be planed without the use of templates or formers, and more accurately than is probably possible by their use, thus avoiding air pockets within the blower and reducing leakage to the minimum.

There is, all over the world, unusual attention being given to building large bridges, as large as the Brooklyn bridge, or larger. It is said that the Brooklyn bridge could be duplicated for about half what it cost.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:
AMERICAN MACHINIST,
203 BROADWAY, NEW YORK

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY
The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, New York.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.
The Wisconsin News Company, Milwaukee, Wis.

The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., or Stefanstrasse 18, LEIPZIG, GERMANY, will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, English currency, or 17 marks per annum, German currency, postpaid.
Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, JULY 27, 1893.

CONTENTS.

	PAGE.
A New Universal Milling Machine	1
Locomotives and Other Early Machines. By W. H. Booth.	1, 2
Smith Shop of Toledo Manual Training School	2, 3, 4
Columbian Exhibition Notes. By F. J. M.	3, 4
Flat Veneer Cutter or Slicer	4
A Shallow Draught Steamer	4
Aerial Navigation Congress	4
A New Hand Drill	5
Letters from Practical Men: A Tool-box. By C. A. Burton ...Motors on the Intramural Railway. By John B. Blood ...The Expected or the Unexpected. By P. S. Dingey....An Error in Speed Variation. By M. E .. Horse-power and Strength of Gear Teeth. By Bell Crank ...Acknowledges the Correction. By John E. Sweet ...Objects to the Method of Finishing on Planer. By Harry M... Some Large Siphons. By Eli H. Pearce	5, 6
Planing Machine for Forming Cycloidal Surfaces	6, 7
Headquarters at the Fair	8
The West Shore Railroad Accident	8
The Cold Storage Fire	8
Questions and Answers	8, 9
The Engineering Association of the South	9, 10
Shop Notes. By B. E. D. Stafford	10
Special Entertainment at the World's Fair—Assignment of Judges	10
Standard Tests and Methods of Testing	10
Things to See at the Fair	10, 11
Personal	11
Manufactures	11, 12
Machinists' Supplies and Iron	12

Headquarters at the Fair.

During the continuance of the Chicago Exposition the AMERICAN MACHINIST will have its headquarters in the space allotted to the Mechanical Press in Machinery Hall. The exact location is Section No. 27, Column K 37. Word can be left with the attendant there by any one who is desirous of meeting a representative of this paper, who may at the time be engaged elsewhere on the grounds.

The West Shore Railroad Accident.

Six persons were recently killed, and some twenty others more or less seriously injured on the West Shore Railroad, the cause of the accident being a misplaced switch. It was one of those accidents that ought to command attention beyond the mere record of the horror, not so much for the purpose of punishing someone for its occurrence as to prevent such accidents—if it is fair to call them accidents—in the future. The coroner's jury censure the switchman, which was possibly the proper thing to do. He was immediately arrested. The railroad company was censured also, but we have not heard of any resultant arrests.

We believe it is an undeniable fact that railroad corporations persistently employ men in positions such as this switchman held, who are incompetent to perform the duties required of them, simply because they will not pay the wages necessary to secure competent men. The public has nothing to do with the question of wages; that is a matter that lies with the men and the companies. But the public has a right to be heard in relation to the qualifications of the men who deal with safety and lives in railroading. The right is there, and it should be seen that, if necessary, the law is also there.

Most people know something about the wages that railroad companies pay such men, and most people make the mistake of supposing that any kind of a man is competent to fill the place filled by this switchman at Newburgh. It is only a question of remembering to do the right thing at the right time, and doing it. But this is just what men get paid very well indeed for. The demand for such men is so great that it is beyond possibility that they will be found turning switches for the pay that a railroad company gives for such service. The services of such men can be had for that very work, but they must be paid in some degree according to what their services will command at some other work. It is a question of supply and demand, and the demand of railroad corporations is not sufficiently urgent.

Undoubtedly this switchman will be punished, probably by imprisonment. His position will be filled by some one who will work cheap, and there the matter will end, so far as the lives and safety of travelers are concerned. It ought not to end there, but judging by all precedent it will. The general government has something to say about the qualifications of the men who look after the lives of those who travel by steamboat and steamships. If nothing else will induce railroad companies to look after the lives of those who travel by rail to the extent of employing competent men in responsible positions, then the general government, or if that is not practicable, the different States should take a hand in the matter.

We do not feel inclined to say much if anything in condemnation of the arrested switchman. As between him and the railroad company—or its officials—we think him the least blameworthy. His qualification that found favor with the railroad officials was a willingness—born of necessity—to work cheap. He was probably quite unable to judge of his own competency—or incompetency—to do the work required of him. But the railroad officials could and should have formed a judgment of his ability without waiting for the evidence of a misplaced switch and a derailed express train.

The Cold Storage Fire.

The burning of the cold storage warehouse at the World's Fair, attended as it was by such a frightful loss of life, is one of the most deplorable and apparently unnecessary calamities that has befallen the enterprise. For though it be shown that the management of the Fair is in no sense responsible for maintaining or allowing upon the grounds such a frightful death trap as this building proved to be, yet it can hardly fail of exerting an adverse influence, as do all those accidents that are of such a character as to strike people with horror.

In the face of all the contradictory evidence upon the matter hardly more than one fact seems definitely settled, and that is, that the firemen who were at the top of the hundred foot tower fighting what appeared to be a small blaze confined to the top, had no business to be there, especially in view of what seems to have been previously recognized as the extremely dangerous character of the building.

After some effort to comprehend the matter we have given up all hope of ever being able to fathom the mysteries surrounding the Fair management, or to understand just where the duty and authority of one officer, board or committee ends and those of another or half a dozen others begins; but it would seem that since the insurance companies had previously canceled all insurance policies upon the building, some one should have seen to it that no lives were lost by its burning.

The destruction of the building seems to have developed the fact that still another and heretofore unsuspected body has some right to exercise authority within the Fair grounds, the city authorities of Chicago having stepped in and declared that the roof of Manufactures and Transportation Buildings must hereafter be kept clear of visitors. Whether the National Commission, the Local Board, the Chicago city government or the concessionnaires really have most authority at the Fair will probably never be definitely settled unless it be by legal proceedings growing out of such a frightful calamity as this of the burned building. We shall hope that in any event the dependent families of the lost men will be abundantly provided for, as now seems likely to be the case.

What seems like a very strange decision has been reached by some one of the numerous World's Fair authorities in the matter of selling goods at the Fair. The sale and delivery of goods from exhibitors' spaces during the exhibition has very properly been placed under regulations; but in this case a New York firm that was exhibiting cheap watches found a demand for them and commenced taking pay from visitors, giving in return therefore not one of the watches on exhibition but an order to deliver a similar watch, this order being valid at a store in the city outside the grounds. The authorities of the Fair decided that this was equivalent to delivering goods, which, it seems to us, is absurd. By such a rule as this a machinery man who should take an order for the duplicate of a machine on exhibition, said duplicate to be shipped at once from the factory, would be delivering goods from his space and could be prevented from doing such business.

This and a number of other incidents which have occurred make one inclined to wish that the world had progressed in civilization far enough either to have something better and more comfortable than any large exhibition can possibly be, or have the business of carrying them on developed into a regular profession with professional exhibition managers to run them.

There is generally a laughable side even to grave matters, Sunday opening at the World's Fair being an example. The rather bitter triangular fight over the question is still fresh. At one corner were those who believed that the grounds would be thronged with disorderly crowds that would commit all manner of excesses. At another corner were those who just as honestly believed that from both a moral and intellectual standpoint Sunday opening would be a good thing, and at the third those who had no interest in the question one way or the other except as a means of making money. The outcome was curious, as well as laughable. In the few Sundays that the Fair grounds were opened there were no disorderly crowds nor excesses. In fact, the crowd was so conspicuously absent that all parties to the contest should consider themselves completely routed. Of them all there is not left even the man who "told you so." But after all, perhaps the most curious thing in the whole matter is that those responsible should have thought that any very large number of people were to be swindled into paying full price for seeing only a fraction of the show. It has, all of it, a laughable side.

As is well known, a letter insufficiently stamped is carried to its destination, where the balance due is collected—that is, if it is provided with a two-cent stamp, its destination being anywhere in the country. This is undoubtedly a matter of considerable importance in many instances, as where, through haste or carelessness it does not have a sufficient value in stamps affixed. But as, in the instance of many other concessions, it appears that this is abused to such an extent that there is some probability of its withdrawal, in which case a letter will not be forwarded unless sufficiently provided with stamps. One way in which this concession is said to be abused is in sending heavy packages purposely understamped on the chance that in the haste at the office it will not be noticed. Another is said to be in the small offices, where the incumbents are quite generally country merchants, and receive a good many packages by mail with postage purposely underpaid.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(366) J. J. D., Newark, N. J., asks: Through how many numbers of the AMERICAN MACHINIST do the articles on mechanical drawing run, and what is the cost of the same? *A.*—This series runs through ninety-three numbers; price, $4.65. Your other two questions are out of our line.

(367) F. F., Waynesboro, Pa., writes: Please advise me of some good book treating on the theory and construction of the gas engine, where it can be bought, and its price. *A.*—The Gas Engine, by D. Clerk, published by John Wiley & Sons, 53 East Tenth street, New York. We believe its price is $2.

(368) B. & C., Brockville, Canada, asks: Can I get tracings or drawings of patents, if so, to whom in the United States shall I apply for them? *A.*—You can obtain specifications and drawings of any patent in print by writing to the Commissioner of Patents, Washington, D. C., stating the name of the patentee, invention, number and date of patent, and inclosing 25 cents for each specification.

(369) E. S. R., Hanover, Pa., writes: Please inform me where I can find illustrations and descriptions of various kinds of friction clutches. *A.*—You will probably find a greater number of friction clutches described and illustrated in our columns than anywhere else. See June 30, 1888; February 14, 1889; February 12 and August 20, 1891; February 25, March 17, and June 30, 1892.

(370) C. S., Brooklyn, N. Y., writes: In looking over your Question and Answer columns I found a question from C. S., Brooklyn—it happened to be the very question that I was going to ask. I should be pleased to know who sent it, as I think C. S. is one of my friends. *A.*—All questions sent to us are considered to be confidential matter, and we never divulge the writer's name without his consent.

(371) G. F., Philadelphia, Pa., asks: Which is the strongest engine, one with a cylinder 20 inches diameter and 36 inches stroke, the other of the same size, but having 18 inches stroke in place of 36 inches, and both running under the same conditions? *A.*—Your question is very indefinite. We assume you wish to know which engine can develop the greater power. The short-stroke engine can be made to develop the same horse-power as the long-stroke engine by allowing it to run at a greater rotative speed. But there are conditions under which one or the other can be used to better advantage.

(372) Country, Lancaster, N. H., writes: I have a slide valve to make for an old engine, cylinder 14 inches diameter and 20 inches stroke. The throw of eccentric is 2¾ inches; steam ports, 1x10 inches; exhaust port, 1⅞ inches wide, and bridges 1¼ inches wide. I intend to increase the width of the exhaust port to 1⅞ inches and give the valve $\frac{7}{16}$ inch lap. Will this be right? Can I get better results by making a new eccentric, and if so, what throw should you advise? *A.*—With a lap of $\frac{7}{16}$ inch there is no necessity for increasing the width of exhaust port or making a new eccentric. With this amount of lap, steam will be cut off at about 18 inches of the stroke, which is not an economical point of cut-off. We should, therefore, advise you to give the valve 1 inch lap, and make a new eccentric of 4 inches throw, or eccentricity 2 inches; with these changes it will be advantageous to increase the width of the exhaust port to 1⅞ inches. With 1 inch lap and the travel of valve being 4 inches, steam will be cut off at ⅞ stroke.

(373) H. J. K., Cornwell, S. C., writes: I inclose dimensions of cylinder and slide valve of a small engine I am repairing, and which I think is faulty in its valve proportions. By actual measurement I find that it cuts off at 5½ inches, compression begins at 6⅜ inches and release at 7 inches, all too early I think for the greatest economy of steam with a plain D slide valve. I have made diagrams to show the relative positions of ports and valve as per your Answer 501 in your issue of November 19, 1891, but can not satisfy myself as to accuracy. I think there is too much outside lap for the length of travel of valve. I would like to know how it compares with the best slide valve practice of the present day, also what changes, if any, you would suggest. Cylinder is 4½ inches diameter and 8 inches stroke; steam ports, ½x3 inches; exhaust port, $\frac{27}{32}$; width of bridges, ½ inch; travel of valve, 1⅞ inches; length of D slide valve, $4\frac{1}{32}$ inches; size of exhaust cavity, 1⅜x3 inches; outside lap, $\frac{19}{32}$; inside lap, $\frac{3}{64}$; lead, $\frac{1}{64}$; usual number of revolutions from 250 to 275 per minute. Connection between valve and eccentric is direct; no rock arm. *A.*—The dimensions given agree well with good practice; we should not advise you to reduce the outside lap, as the engine cuts off late enough. We recommend no change.

(374) J. C. J., Salvatierra, Mexico, writes: I am about to build a wrought-iron smokestack for a boiler of 100 horse-power. I intend to make the smoke pipe 36 or 40 inches in diameter, and about 45 feet high; the thickness of the iron is to be about $\frac{1}{16}$-inch thick. Kindly let me know if I am right or not. *A.*—The term horse-power of a boiler is a very indefinite one, and cannot be used for computing the size of the chimney; the amount of coal burnt will determine its size. Assuming that 400 pounds of coal is to be burnt per hour, you will require a chimney 30 inches diameter and 60 feet high. The thickness of iron proposed by you is too small; we should use iron $\frac{5}{16}$-inch thick, corresponding to No. 7 Birmingham wire gauge, for the lower part of the pipe extending upwards about 20 feet, and for the remainder of the pipe, a thickness of ¼-inch full corresponding to No. 9 B. W. G. 2. What should be the diameter and length of rivets? *A.*—We should use rivets ¾-inch in diameter and 1 inch long for the lower sheets, and for upper sheets ⅞-inch long; pitch of rivets, 1½ inch. 3. Can I get sheets long enough to make each course out of one sheet, or would it be best to piece them? *A.*—That depends on the facilities you have for handling the sheets and for erecting the chimney. We should prefer to make each course out of one sheet; you can obtain sheets long enough for that purpose. 4. I would also esteem it a great favor if you would give a rough sketch of rolls for bending plates. *A.*—We should be pleased to do so, but we have no drawings of rolls at hand. You will find perspective views of rolls for bending sheets in our issues of July 2, 1891, April 21, May 12, and December 22, 1892, and others in previous issues. These may be of aid to you in making a design of rolls.

(375) A. H. F., Springfield, Ohio, writes: Please publish in your columns a description of the blue printing process. *A.*—This is an ever recurring request, but since the process is an important and useful one, we give the following reprint of an answer describing the process and a simple outfit required, which any one can easily make for himself for home or office use: Procure an ordinary picture frame and glass; into the frame fit a back or wooden board about ½ of an inch thick, cover one side of this board with three thicknesses of flannel, and on the rear of the frame screw loosely four buttons so that the back or wooden board can be kept in the frame. Dissolve 2 ounces of citrate of iron and ammonia in 8½ ounces of water; also dissolve 1⅓ ounces of red prussiate of potash in 8½ ounces of water; when the two are dissolved mix them in a dark bottle and keep it in a dark place for future use. Procure sheets of paper somewhat smaller than the inside of the frame. The paper should have a hard surface, so that the liquid cannot easily soak into it. Coat this paper with the solution previously prepared; to do this use a sponge dipped into the solution and then draw the sponge lengthwise and crosswise on the paper so that the paper will receive an even coating, and hang it in a dark room or closet to dry; when dry keep the paper in a dark place. When a blue print is to be taken, place the tracing in the frame with its face on the glass, on the tracing place the paper with its coated face on the tracing; on this paper place the board with the flannel in contact with the paper and fasten the board into position by means of the buttons attached to the frame. Expose the tracing to a strong sunlight for about 3½ to 4 minutes, then take the paper out of the frame and place it in a tub of water and let it remain there for about 5 minutes; after this take it out and let it dry, and thereby finishing the blue print. In connection with this see AMERICAN MACHINIST, page 1, January 29, 1887.

(376) F. Y., Horton, Kansas, writes: Please give me a method for computing the horse-power of an engine from an indicator card. *A.*—For computing the horse-power we have to find simply the mean effective pressure from the diagram. The most expeditious way to measure the mean effective pressure represented by the diagram is by means of the planimeter or averaging instrument; but as such an instrument is not always at hand, it may by careful working be very accurately done by dividing the diagram into a number of equal parts, say 10, measuring the height of each division, adding these measurements together, and dividing the sum by the number of divisions. The only reason for making the number of divisions 10 is for convenience; some prefer to make the number 20, as tending to greater accuracy. The height can be measured by a scale of pounds, the measurements added together and divided by 10, the result appearing in pounds; or the measurements can be made by a scale of inches, the sum multiplied by the scale of the spring, and divided by 10, giving the result as before. As tending to greater accuracy, however, it is advisable to make the measurements continuous. For this purpose a strip of paper is used, which is carried from one division to another, the measure of each being pricked or marked beyond the preceding one, so that the distance from the end of the strip to the last mark will represent the sum of the ten measurements. Frequently the heights of these divisions are measured at their centers, but it should not be inferred that this will always be correct. It would be more nearly true to say that it will never be correct. It is the mean height of each division that is required, and the eye will generally determine whether this will result from measuring at the center. After the mean effective pressure has been obtained as explained above, then the ordinary rule for finding the horse-power is followed, which is: Multiply the mean net area of the cylinder in inches (the total area less one-half the area of the piston rod) by the mean effective pressure as found above, multiply this by the piston speed in feet per minute and divide this product by 33,000; the result will be the indicated horse power. The amount of work done on one side of the piston may differ materially from that done on the other side, and almost invariably does differ to some extent. For this reason, in finding the horse-power developed, it is necessary to measure diagrams from both ends of the cylinder; the average mean effective pressure of the two will be that required. The method here explained for finding the mean effective pressure from the diagram does not hold true where the expansion is carried so far that the expansion line crosses the line of counter-pressure, but this is only likely to be met with in the case of a non-condensing engine cutting off short, as when lightly loaded. The method also fails to give correct results when compression is carried to such an extent that a loop will be formed at the termination of the return and beginning of the forward stroke, but cases of this kind are of rare occurrence. For finding the mean effective pressure in the last two cases we must refer you to "Indicator Practice" and Steam Engine Economy, by F. F. Hemenway.

(377) Ludlow, ——, Mass., writes: Please inform me how much power I can obtain from a water motor, the water having a fall of 90 feet, flowing through 500 feet of 1, 1½ or 2-inch pipe. Please give the amount of power from each of these pipes. *A.*—We shall give the computation of the energy of the flow of water through the 2-inch pipe; the energy of the flow through the smaller pipes you can find in the same way. First find the velocity of the discharge by the following formula:

$$v = 48\sqrt{\frac{h}{l}} \times d,$$

in which v = velocity in feet per second, h = head in feet, l = length of pipe in feet, d = diameter of pipe in feet. The diameter of the 2-inch pipe in feet is .166; substituting for the symbols their values, we have

$$v = 48\sqrt{\frac{90}{500}} \times .166 = 8.25$$

feet per second. For finding the stored-up energy of this flow of water, we use the following formula:

$$K = .01555 \times w \times a \times v^3. \qquad (2)$$

in which w = weight of water per cubic foot = 62.5 pounds, a = area of pipe in square feet = $\frac{3.1416}{144} = .0218$, v = the velocity in feet per second, as found above, and K = stored-up energy in foot pounds. Substituting for the symbols in equation (2) their values, we have

$K = .01555 \times 62.5 \times .0218 \times 8.25^3 =$ 11.84 foot-pounds per second; the horse-power of this is equal to

$$\frac{11.84}{550} = .0215.$$

This is the theoretic energy in horse power of the water as it flows out of the pipe, which is very small, because nearly the whole head is lost in overcoming the friction in the pipe. For power producing purposes the exit diameter of the pipe must be made less than 2 inches, so as to reduce the velocity of the water in the pipe and thereby obtain a fair amount of effective head. We will take a fair medium velocity of 3 feet per second, then the friction head by Cox's formula is,

$$F = \frac{l}{1{,}200\,d}\ (4\,v^2 + 5\,v - 2)$$

which gives us,

$$\text{Friction head} = \frac{500}{1{,}200 \times 2}\ (36 + 15 - 2) =$$

10.2 feet. We now require to find the discharge, for which we have,

$$\text{Discharge} = \frac{v \times 12 \times 60 \times \text{area pipe in}}{1{,}728}$$

$$\text{inches} = \frac{3 \times 3.1416 \times 720}{1{,}728} = 3.92 \text{ cubic}$$

feet per minute. Now to find the horse-power obtainable, we have, assuming an efficiency of 85 per cent. in the motor, $H\,P =$

$$\frac{\text{Effective head} \times \text{discharge} \times 62.45 \times 85}{33{,}000 \times 100}$$

$$= \frac{(90 - 10.2) \times 3.92 \times 62.45 \times 85}{33{,}000 \times 100}$$

= 0.5 horse-power. It must be borne in mind that we have assumed a *clean cast-iron pipe;* if otherwise, the friction head would be increased, and the consequent horse-power considerably reduced. 2. Please give me the address of any firm who make motors suitable for this purpose. *A.*—Backus Water Motor Co., Newark, N. J. The Pelton water motor has also a good reputation.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's gears, Lex'n, Mass., & Phila., Pa See p. 12.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mil., Wis.

Agents Wanted—Scientific Machinist, Clev'd, O.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Magic Crushers.
G. T. McLauthlin & Co., 120 Fulton St., Boston.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

Gear and Rack Cutting, Drawings for Bevel & Miter Gears, Cutters for Spur & Bevel Gears Milling Cutt's, Vert'l Mill'g Mach's. R.M.Clough, Tolland Ct.

"Pumping Machinery." New book, 450 pp, 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

12-inch breech-loading rifled mortar & mounting, w'ght 118,000 lbs., front Gov't B'ld'g, World's Fair; des'n on applica'n. Builders Iron F'dry, Prov., R. I.

Gear Cutters. Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

Something new in name plates; "oxidized aluminum"; write for sample. Finest castings in the world, made by patent pressure process. Passaic Art Casting Co., 35 Warren St., New York.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
111 Broadway, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

The Engineering Association of the South.

At the meeting of the Engineering Association of the South, Nashville, Tenn., July 13th, the subject of "Smoke Prevention" was presented by Prof. Olin H. Landreth, of Vanderbilt University. The paper discussed successively the causes, the effects of smoke and the remedies for it. Objectionable smoke comes mostly from bituminous coal, other fuels producing very little smoke. When fresh coal is thrown on incandescent coal, there at once begins the distillation of the more volatile hydro-carbons, which distilled matter is burned if sufficient oxygen is present and the temperature is sufficiently high, but which otherwise passes up the chimney as yellowish fumes. As the fresh coal becomes more highly heated, the less volatile hydro carbons are distilled, and are decomposed at a temperature much below that necessary for the combustion of the carbon liberated, about 2,000 degrees F., a temperature so high as to give considerable margin of opportunity for this portion of the carbon to escape unburned. It is this free, unburned carbon in a finely divided state that, while incandescent, produces the luminous flame, and, when cooled, the clouds of smoke that issue from the chimney and afterwards settle as soot. After the volatile matter is driven off, the fixed carbon remains, and in burning produces but little flame and no smoke, since the particles of carbon are not detached from the solid mass till combustion takes place. As to the effects of smoke production, the fuel loss in the smoke itself is but small, estimated at one sixth of one per cent; but the causes of smoke are also the causes of imperfect combustion and consequent waste of fuel in the form of invisible gases, carbonic oxide and light hydro carbons, and the presence of smoke indicates this parallel waste. Aside from the fuel waste, the effects of smoke outside the furnace make its abatement of public interest. It is authoritatively stated that the residuum of smoke in the lungs induces consumption of an incurable character, and that, in the city of Pittsburgh, Pa., the death rate was 1.62 per 1,000 lower during the eight years in which the use of natural gas almost freed the city from smoke, as compared with the preceding eight years, and that, since the partial return of smoke, the rate has increased 2.57 per 1,000. Carbon in a finely divided state is an easy vehicle both for noxious gases and organic impurities. The insidious soot pervades and defaces public and private buildings and calls for fruitless efforts for cleanliness, when cleanliness is impossible. Smoke is objectionable from the loss of light and increased cost of artificial light; also from the repression of esthetic tendencies and consequent mental and moral discouragement. . . . Considera-

tion of the causes suggests the agencies and the mechanical devices for the prevention of smoke; these latter, so far as pertains to steam boilers, are classed as mechanical stokers, air flues in the walls and grate bars, coking arches, dead plates, down-draught furnaces, steam jets for injecting air and mixing the gases, baffle plates and double furnaces. Smoke prevention must be accomplished by educating the public to consider smoke a nuisance that unquestionably can and should be abated, for the smoke producers are very slow to be convinced that this abatement is to their interest. Following the influence of public sentiment, laws are to be enacted and provision made for their enforcement and for furnishing to smoke producers, when desired, professional advice regarding the means and appliances for smoke prevention. The paper gives the statutes passed in Chicago, Cincinnati, Cleveland, Pittsburgh, New York, Rochester, Boston, Denver, the State of Ohio, and the city of Birmingham, Eng., with statements of the success attained in preventing smoke in these localities, success in each case being proportional to the vigor of action taken; it also contains descriptions of various mechanical devices for smoke consumption, and closes with a list of literature on the subject.

The next meeting of the association will be held September 14th.

WALTER G. KIRKPATRICK, Secretary.

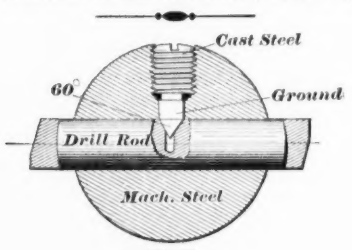


Fig. 1

Shop Notes.

BY B. E. D. STAFFORD.

A very effective and quickly made boring cutter (Fig. 1) for use in the turrets of chucking machines or in the regular individual boring bars, and one that will position itself accurately, when made right, is made by using the standard drill rods $\frac{1}{2}''$, $\frac{5}{8}''$ and $\frac{3}{4}''$ in diameter, and making the bar as is shown in the sketch, Fig. 1. Make a stiff bar of good material, and put the cutter hole in as central as possible; then at right angles and central with the bar drill and tap for the screw as shown. As the drill rods are generally

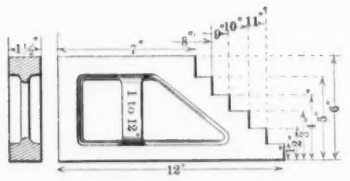


Fig. 2

standard as to their diameters, a regular reamer a little worn will leave a good fit for the cutter. The screw should be made of cast steel, hardened, and the straight part and point ground. The point of accuracy, as to fit of cutter to the bar, is governed by the nicety with which the straight part of the screw, as also the thread, fits the hole in the bar. This does not differ from other tools that are interchangeable, where positions of accuracy and perfect results are looked for; if the tool is made perfect the results will be satisfactory. It will be noticed by the sketch that the cutter is drilled in addition to being countersunk, this not only being a lead and clearance for the countersink, but forming a space for small particles of dirt that might collect on the point of the screw, which is usually the case, as sometimes the steel becomes magnetized.

The cutters can be quickly cut from the bars or rods in a chuck leaving enough to size when fixed in bar. When cut drill and countersink by a small jig, fix in bar with screw and form cutter on centers in lathe, leaving enough to grind, if bar is short enough for grinder, or stone afterwards in the lathe if bar is long, after the necessary clearance has been filed, and cutter hardened. It is well to have two roughing tools and a finish for reaming, not reaming over .005".

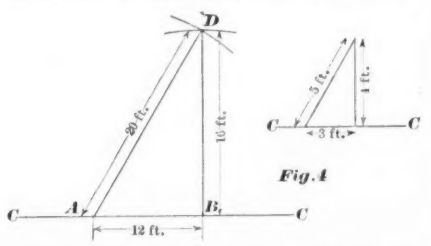


Fig. 4

Parties doing a great deal of chucking ranging from $1\frac{1}{4}''$ to 4" will for a turret tool find this, if built proportionately, an economic one.

A very convenient set of test blocks for planer use are made as follows, and, if made accurately, are indispensable to a gauge department:

Plane up a strip of cast-iron or steel $1\frac{1}{2}''$ x 1" long enough to cut into blocks that will finish for thickness the following sizes: $\frac{1}{16}''$, $\frac{3}{32}''$, $\frac{1}{8}''$, $\frac{3}{16}''$, $\frac{1}{4}''$, $\frac{5}{16}''$, $\frac{3}{8}''$, $\frac{7}{16}''$, $\frac{1}{2}''$, $\frac{5}{8}''$, $\frac{3}{4}''$, and $\frac{7}{8}''$; make and plane up a gauge like the sketch, Fig. 2, and it gives you by using the blocks, measurements from $\frac{1}{16}''$ to 12" by $\frac{1}{32}''$.

I once had occasion to remove from a 4" shaft a lot of 5 and 6 foot 12" face pulleys (clamp) that hung 12 feet high. Generally they are awkward things to handle, but by using the split collars and chain-falls as shown in Fig. 3, it was mere play as to former methods.

These collars are made of cast-iron, in halves, the upper half having two lugs that extend out over the hubs of the pulley. These are planed, screwed together and bored out so as to fit the shaft tightly. Put set-screws in the lugs near the end as shown. To remove a pulley you proceed as follows:

Turn the shafting until the pulley split stands horizontally Screw into the floor, central with the face of the pulley, and 6" from its diameter each side, an eyebolt, and hang thereon the chain-falls, and connect each by fastenings to the lower half of the pulley. Put a split collar on the shaft each side of the pulley with the lugs extending over the hub of the upper half and screw up tight. Unbolt the lower half of the pulley and lower it to the floor with the falls, the upper half kept in place by the collars and the key. Turn the shafting so that the upper half hangs, and lower as before.

I have a great many times had occasion to lay off floors for large planers and woodworking machines where I had to strike a line at right angles to the main line without any instruments such as engineer's level and sights, but by plumb line and tape, using the angle 3, 4, 5 or 6, 8, 10, as it is called, but which is 53°+, the mode of operation being as follows:

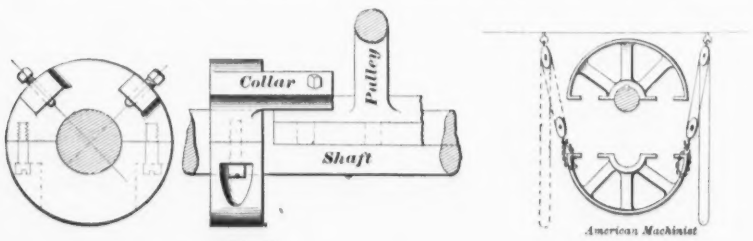


Fig. 3

From the main line plumb down to the floor and spot in two places, say 12 feet apart, then with chalked twine make a chalk line on the floor striking these two spots; this gives you a line on the floor corresponding with the line of the main shaft.

As per sketch, *C C* (Fig 2) is the line of the shaft, this line to be used as the base of the angle we wish to lay off. As 3, 4, 5 or 6, 8, 10 feet would not be large enough to take in the required space, we carry it out proportionately, and make it 12, 16 and 20 feet. On *C C* lay off 12 feet exactly and drive in a round nail. With tape draw a 16-foot arc, from point *B*, and from point *A* intersect this with an arc 20 feet as shown. Then with chalk line on the floor mark from point *B* to intersecting point *D*, and from point *A* to intersecting point *D*, which is a right angle triangle.

This angle has come into use a great number of times in my experience; without the knowledge of it I should be at a loss to know how to proceed with the job, not having instruments or data at hand.

Special Entertainment at the World's Fair—Assignment of Judges.

(*By Telegraph.*)

The assistant chief of the Department of Machinery at the World's Fair, Mr. Porter, who is a member of the A. S. M. E., has been making arrangements for some special entertainment of that society and its foreign guests on Monday the 31st of August. That day will be known as mechanical engineers' day at the Fair, and at 2 P. M. the Whaleback passenger steamer "Christopher Columbus" will leave the city for the grounds with the party on board. Drawings showing the construction of the ship will be exhibited, and its designer will be on board to give information regarding it. Arrived at the grounds, a trip will be made over the multiple platform railway, after which there will be a meeting at Music Hall in the grounds, at which the engineer corps of the World's Fair will be present, and will explain the engineering features of the work of construction. Maps and profiles will show the progress of the work each month. Then will follow visits to the special engineering features of the Exhibition and a light supper, which is to be given by the Henry R. Worthington Company at its pumping station. The evening will be devoted to some form of entertainment not yet decided upon.

The judges in the Department of Machinery have been selected and partially assigned to the different groups. The assignment is not yet sufficiently completed to be given, but the names of judges are as follows: U. S. Judges—Prof. James E. Denton, Hoboken, N. J.; Wm. J. Young, Clinton, Iowa; John A. Roche, Chicago; L. C. Billings, Midford, N. H.; Geo. H. Barrus, Boston; Prof. Louis E. Reber, Pennsylvania State College; O. E. Smith, Norfolk, Va.; Wm. Sooy Smith, ——; W. C. Lemert, Bucyrus, Ohio; Marcellus Gould, Manchester, N. H.; Frank P. Holt, Laconia, N. H.; Wm. C. Margedant, Hamilton, Ohio; Thos. R. Pickering, Portland, Conn.; A. J. Monocal, Washington, D. C.; P. J. McMahon, ——; A. S. Capehart, ——.

Foreign Judges—Mr. Massey, England; Mr. Burger, Switzerland; Louis Caunon, Belgium; Alexis Galzook, Russia; V. L. Kirpicheff, Russia; Axel Welin, Sweden; Prof. W. C. Unwin, England; E. Blum, Berlin; Prof. W. Hartman, Berlin; L. Erhard, Nurenberg; C. Heller, Stuttgart; Professor Vogel, Berlin; R. D. Gehemer, Stuttgart; Director Haarmaan, Osnabruck; Moritz Seifert, Austria. At a meeting of the machinery judges John A. Roche was elected president.

Standard Tests and Methods of Testing.

We gladly give space to the following, which explains itself. The subject of getting down to a universal standard for tests is one that is attracting a good deal of attention, though scarcely so much as it deserves. It should be as easy for engineers to read, understandingly, tests made in any part of the world, though clothed in scanty text, as it is to read mechanical drawings. Now the comprehension of the records of a test are almost invariably in doubt in some points, however elaborate the text. It ought not to require argument—and it probably does not—to convince engineers of the importance of this, but there is, of course, a great deal of work to be done in bringing it about. Mr. Henning, who brings the matter to our attention, is, as a member of the committee of the A. S. M. E., a most earnest worker, being described by the chairman of that committee as "emphatically the working member." He has been to Europe in the interests of the society in the matter, and otherwise interested himself:

Editor American Machinist:

August 1, Tuesday morning, the Mechanical Engineering Section, Engineering Congress, World's Fair (A. S. M. E.) will be devoted largely to the report of the Committee on Standard Tests and Methods of Testing, and Prof. A. Martens, Director of the Royal Prussian Testing Laboratory, as representative of the German conferences, and Prof. Paul Debray, official representative of France, besides a number of other European engineers, will be present. The object of giving prominence to this meeting and urging as large an attendance on the part of American engineers and manufacturers as possible, is to make the deliberations thoroughly representative and international, for the purpose of making further and continued interchange of ideas and facts possible by the advocacy of an international committee containing representatives from all our societies and the principal technical schools and industrial and railway establishments. The success and international character of the German conferences has been so satisfactory, that it is hoped that this meeting may still further increase general interest in standard methods of testing, and lead to general dissemination of exact knowledge of its great practical value.

Hoping that you can insert a note to this effect in your valuable paper, and if possible a few lines in your editorial column,

I am, yours very truly,

GUS. C. HENNING,

Reporter to the Committee on Standard Tests and Methods of Testing, A. S. M. E.

Things to See at the Fair—Continued.*

FRIEND HEMENWAY: I see that you have made such liberal extracts from my first letter that it behooves me to write with more care, otherwise I shall have another set of the believers in the superiority of the American Eagle calling me down, as the saying goes.

Reverting to the engine exhibit. I was sorry to see that none of the English engine builders, except Galloway and Willans & Robinson, were represented. I doubt if the Galloway people are rated among the best builders, and while their engine may appear somewhat novel to us, and the passage from high to low pressure cylinder quite short, they are not so in reality, as the steam has to go from the front end of one cylinder to the back end of the other, a distance practically as far as in a tandem compound, so that about all the advantage that there can be over the tandem is a shorter engine and possibly a little advantage in the relative times between H. P. exhaust and L. P. admission. It does not appear to me to be a representative English engine. The Willans & Robinson is by the records, and, I think, undisputably the most economical of all the high-speed class, notwithstanding it has three points which are pretty generally believed detrimental to economy—throttling, single-acting and high speed. I did not see it run, but understand it is doing nicely. Outside of what one can see and hear in its running, it is peculiar in this, that it is built absolutely interchangeable and likely the only engine of much size possessing any degree of absolutely accurate work ever so built. Of course, it is easy to build cheap work interchangeable, and, too, we all build

* By permission.

interchangeable work in our catalogues, but such a thing as making parts in lots from frames to fly-wheels, put them in cupboards or pockets, and when a certain size engine is called for go to the cupboards and get the pieces, assemble them in the shipping room and send out the perfect engine, so far as I know we simply do not do it, and the Willans & Robinson people do. Now I really do not know whether it is a better engine than is built in this country or not; for certain purposes I am pretty certain it is not, but the way they are building them is nearer the manufacturing of steam engines than we have as yet reached.

Two or three features in the American section among the novelties which I failed to mention was a trick the Buckeye Engine Co. adopted to get a temporary change in the cut-off on the intermediate and low-pressure cylinders of their triple expansion engine. Likely you will have drawings of it. It is one of those strokes of genius they are given to, but I cannot see why they and their imitators persist in calling a certain form of bed a "Tangye Bed," when, as a matter of fact, Charles T. Porter exhibited his engine in Paris two or three years before the Tangye people ever built an engine. It may be this, that Tangys tried to imitate the Porter bed, and failing, called it the "Tangye," and others trying the same thing, and, failing, called theirs the "Tanyge bed" also.

Other novelties are cam motions for working Corliss valves and examples of valves in the cylinder head, both of which, if of much size, I should want to run the first engine a good while before building the second. In the latter case I should expect the spring of the head to upset both the fit and the endurance.

The placing of the low-pressure cylinder of compound engines furthest from rather than next the crank seems to be gaining favor both with and without the intervening space. Three or four on exhibition have the intermediate head put through the low-pressure cylinder. Perhaps now would be a good time to settle who was first to do this, or it may be like many another new thing—very old. We at the Straight Line Engine Works are building an engine to do away with even that, using two rods to the low-pressure piston over and under the H. P. cylinder, taking out the low-pressure piston away from and the H. P. piston towards the crank, thus shortening the engine a foot or so, doing away with the internal and one might say infernal intermediate stuffing-box entirely.

Having had a whack at an attempt to circumvent type-setting some thirty years ago, I have never lost interest in that branch of mechanics, and if one wants to see concentrated ingenuity he will find it among the type-setting and lineotype machines on exhibition in American section in Machinery Hall, and if one wants to learn what good workmanship is in a certain way he can get valuable experience by monkeying with a machine dealing with printer's type. I need not attempt to tell you about the lineotype or type-setting machine and simply mention this as a text, and it would furnish many of them.

Whenever a machine has been devised to do hand-work any attempt to introduce it meets with opposition from the workmen, and after the machine has made its way the wages of the workmen advance. Likely the type-setters' union raised less opposition to the machines than other tradesmen, less than the molders are likely to raise against molding machines, and they will all the sooner begin to benefit by standing on a higher level. The machines do the drudgery and the workmen do the better part of the work, get better pay because it is a higher average and all are kept employed because the machine cheapens the work and there is more of it done. When enough molding machines are running to ram the sand the foundrymen will become something besides sand rammers and get paid accordingly. This is not describing things at the Exhibition, but reading the lessons. The lessons are the least interesting, but if we read them correctly may be of the most value.

Putting the power plant as a part of the machinery exhibit has its advantages and disadvantages. There is, if anything, too little room under the floor for the ramification of steam pipes and electric wires, and yet so much as to make the engine foundations very expensive; far too much height for the every-day machine exhibits, as cost of foundation is a large item to the exhibitors. Charging the exhibitors for power, so far as I know, was an unheard-of proceeding and a great mistake.

Machine builders going to the expense of a show and then not showing their product is like a pantomime with the lights turned off.

The difference in the attendance at the Fair Sundays and week-days shows that the people go when they can see the "wheels go round," and do not when they can not, and so with Machinery Hall, visitors and sight-seers crowd around the machine that goes humming and pass the idle one by without notice. They pass by the gilded lathe or tattooed engine with a smile, but stop to look at the machine that pares off shavings.

JOHN E. SWEET.

Personal.

We are informed by Mr. Charles Churchill, of Charles Churchill & Co., London, that he will arrive in New York on August 4, and that letters can be forwarded to him at all times care of Messrs. Parke, Davis & Co., 90 Maiden lane, New York, or August 28 to September 2 can be sent care of W. Pickett & Son, 113 Lake street, Chicago.

W. S. Rogers, superintendent for M. C. Hammett, Troy, N. Y., has accepted a position as manager with the Troy Valve Co., of that city.

MANUFACTURES.

The Catawissa (Pa.) Pulp-mill is to be enlarged.

A paper-mill may be built at Hot Spring, S. Dak.

George Scott is to erect wagon works at Myrtle Springs, Tex.

W. T. Watts will establish a tannery and leather factory at Waco, Tex.

Ansel Dickinson's Sons are building a new box plant in Winchester, N. H.

Sawyer & McCoy are building a new saw and shingle-mill at Helena, Ark.

J. & S. Barnes, of Greensboro, will erect an ice factory in Fayetteville, N. C.

J. F. Mahanna, of Lenox, is to erect brick-making works at Lenox, Mass.

The Flint Woolen-mills, at Flint, Mich., are erecting an addition, 48x168 feet.

W. N. Saunders is to erect a saw-mill of 20,000 feet daily capacity, at Conroe, Tex.

The Pioneer Paper Stock Co., at Chicago, will erect a brick building of four stories.

The Shamokin (Pa.) Car Works Co. intends to erect an additional shop, 274x103 feet in size.

The Canada Colored Cotton mills Co. is spending about $200,000 in improving their mills in Cornwall, Ont.

The Social Mills, Woonsocket, R. I., is to add to its plant by building a one story weave shop 200x50 feet.

H. H. Poland, of Tyler, Tex., is contemplating the erection of a large iron rolling-mill at that place.

I. N. Megargee & Co., Philadelphia, Pa., are negotiating for a site on which to establish a paper-mill.

The Niles Tool Works, Hamilton, O., have completed plans for a new foundry building 120x400 feet in size.

A. Cushman, of Houston, Tex., intends to erect an iron foundry upon a tract of land recently purchased there.

The Peacher's Mill Company, of Peacher's Mills, Tenn., will build a woolen factory of 400 yards daily capacity.

W. W. Ham & Co. will increase their facilities by the addition of improved machinery to their shoe factory at Haverhill, Mass.

The Troy Valve Co., Troy, N. Y., are getting ready to push the business of making valves, and will soon put in considerable new machinery.

The boilers, steam pipes, etc., of the new gunboat "Machias" are covered with asbestos fire-felt covering from H. W. Johns Mfg. Co., New York.

The Philadelphia Traction Company will increase its capital stock from $7,000,000 to $9 000,000, to equip the company's line with the electric-trolley system.

The Washburn Shops, Worcester Polytechnic Institute, issue a catalogue illustrating and describing the Worcester drill grinder in different forms and sizes.

The Conklin Wagon Co. has been organized to manufacture wagons in Olean, N. Y. Capital, $250,000. Directors: William H. Conklin, Charles F. Turner and others.

W. J. Dowling, Dayton, Wash., writes: "I am putting in a foundry and machine shop here to do jobbing work and would be pleased to receive catalogues and prices of tools."

The firm of Pancoast & Maule, Philadelphia, Pa., has been succeeded in business by Henry B. Pancoast & Co., who will continue the manufacture of pipe tools, etc., as before the change.

The Tabor Manufacturing Co., 113 Liberty Street, New York, has issued a folding catalogue of automatic molding machines for metal castings. It contains illustrations and descriptions of different machines made by the company.

The Trenton (N. J.) Electric Construction Co., capital stock $25,000, has been formed to manufacture electrical apparatus. G. F. Applegate, J. P. Toman, C. F. Adam and Paul Lupke are the organizers.

The Maine Electrical Construction Co., Fairfield, Me., capital stock, $10,000, has been organized to construct and equip electrical plants. C. H. Maxfield, F. E. Vickery, B. F. Maxwell and J. R. Donnelly are interested.

Perkins & Company, Grand Rapids, Mich., have issued a catalogue "Columbia Edition," standard size, of shingle mill machinery, of which they are large manufacturers. The catalogue is quite complete and interesting.

The Bickford Drill and Tool Co., Cincinnati, O., write us that they have purchased the patterns, drawings, special tools and fixtures formerly used by the Universal Radial Drill Co., and can promptly furnish repairs for machines of this make.

Pratt & Whitney Company, Hartford, Conn., have issued a new and enlarged catalogue of machine tools, small tools, gauges, taps, dies, reamers, punches, drop hammers, etc. It is quite fully illustrated and covers a large variety of machines and tools.

The Oswego (N. Y.) Machine Company will build a new plant. The structure will be of stone and brick, 200 feet long and 60 feet wide. The engine and boiler house will be in a separate building. The construction of the new building will be pushed as rapidly as possible.

The Merchants' Manufacturing Co., of St. Henri, Que., is making extensive additions to its cotton-mill. The company is building a new wing, 100x215 feet, five stories high, to correspond with the present building. This addition will increase the capacity of the plant 50 per cent.

An addition, 54x25, is building at the south side of the engine house of Bennett Mill No. 1, New Bedford, Mass., to make room for an additional engine for that mill. The boiler house is also being enlarged by an additional building, 40x20, to make room for two more boilers.

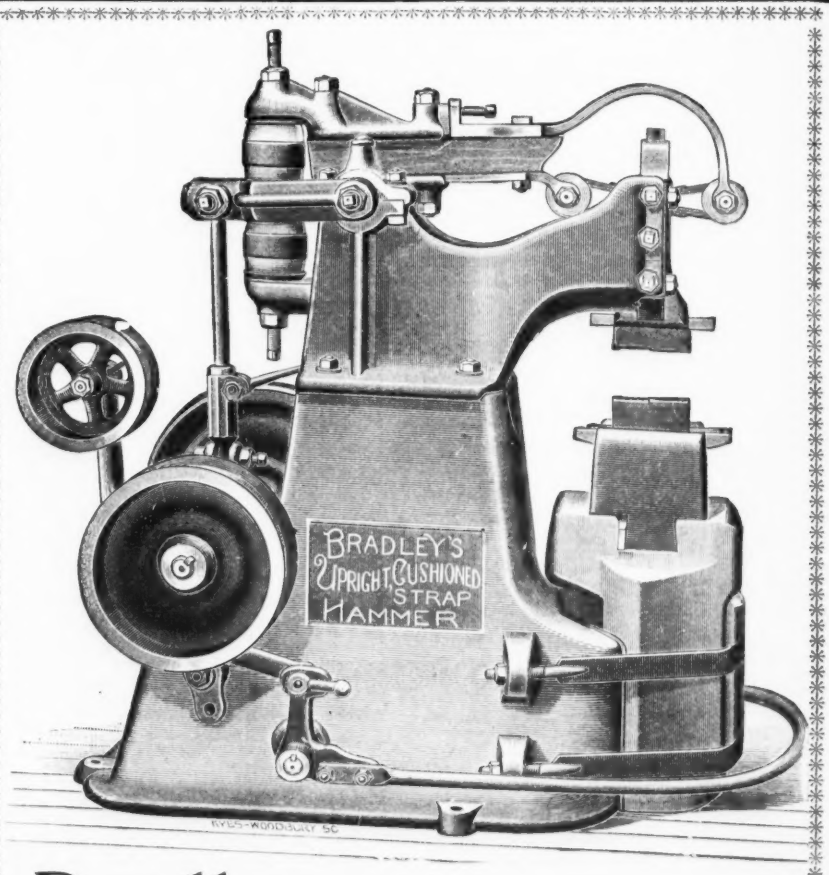
Messrs. Laramore & Freeman, of Cartersville, Ga., intend to engage in the manufacture of hosiery in the near future, and are now seeking estimates on machinery. They will utilize water for operating power, and will turn out 50 to 100 dozen socks and ladies' hose daily.

The mill building of the Newberry cotton mills at Newberry, S. C., will be enlarged very soon. The plant is now operating 11,000 spindles which equipment is to be increased to 25 000. These improvements were decided upon at the stockholders' meeting in May, as previously noted. The improvements will all be completed within a year.

James H. Wells (Tampa Machine Works), Tampa, Fla., writes us: In the AMERICAN MACHINIST dated 13th I find a statement that the South Florida Iron Works Co., of Tampa, Fla., will establish an iron foundry, etc. I would say that the name is incorrect. Please state that the Tampa Machine Works is to have a foundry ready for work about October 1st.

Belding, Paul & Co., silk manufacturers, Montreal, Que., are building a new wing to their plant 150x45 feet, four stories in height, to correspond with their present building, thereby increasing the capacity fully 50 per cent. A new boiler house is also being erected, and a new dyehouse will be built next year. The wing in which will be located the firm's ribbon and weaving will be completed about September 1.

The Penberthy Injector Co., of Detroit, Mich., say that in spite of the dull times their business is steadily increasing. Since completing the additions to their factory they have added eight new speed and monitor lathes to their plant, also a new Reed engine lathe and a universal milling machine to their tool room outfit. The capacity of their works is now 2,000 machines a month, and they are yet unable to accumulate stock, but are frequently behind their orders.



Bradley Hammers.

If you plate, draw, square, taper or weld iron and steel, you need a Bradley Hammer.

If you swage, collar, spindle, or do any manner of die work, a Bradley Hammer will soon pay for itself.

That the Bradley is the best Power Hammer in the market has never been questioned. Our circulars illustrate, describe, give sizes and prices.

BRANCHES: 114 Warren St., New York. 196-98 Sudbury St., Boston.

BRADLEY & COMPANY, Syracuse, N. Y.

Brown & Sharpe Mfg. Co. and Darling, Brown & Sharpe, Providence, R. I., make the following announcement: Our works will be closed from July 31 to August 12, inclusive, for annual vacation and repairs. Please bear this in mind in connection with any orders you have in contemplation. The office will be kept open as usual, and all orders will be promptly filled for machinery or tools described in our catalogues, and usually kept in stock.

Machinists' Supplies and Iron.

NEW YORK, July 22, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.75 to $14.50 for No. 1 Foundry; $12.50 to $13.50 for No. 2 and $11.75 to $12.50 for Gray Forge.

Antimony—The market is steady. We quote L. X., 10.20c. to 10¼c.; Cookson's, 10.35c. to 10½c.; Hallett's, 9.80c. to 9.85c., and U. S. French Star, 10½c.

Copper—The market continues weak. There are a few offerings of Lake Copper at 10⅜c. for spot and 10½c. for futures. Buyers are bidding 10c. for spot or futures. Casting Copper is held at 9¾c. to 10c.

Lead—The market is steady at 3.50c. to 3.55c., with sales at the first-named figure.

Lard Oil—Prime City is quoted at 72c. to 73c.

Spelter—The prices are lower, holders are asking 4c. to 4.05c. for New York delivery; buyers are bidding 3.87½c.

Tin—The following prices have been realized in speculative sales: Spot at 19.10c. to 19.12½c.; July, 19.15c.; August, 19c. to 19.20c.; and September, 19.55c

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

An exp'd supt. of machine works and foundry is open to an engagement. Box 33, AM. MACHINIST.

Wanted—Draftsmen to sell new comb. triangle, pat. protractor, etc. D. J. Kelsey, New Haven, Ct.

Draftsman experienced in erecting steam and ammonia plants wants position. Box 46, AM. MACH.

Wanted position by experienced mechanical draftsman. Address A, care AM. MACHINIST.

Mechanical Draftsman, 10 yrs. exp. desires change, can furnish best ref. Address Box 54, AM. MACH.

Situation wanted by first-class pattern maker. Address L., care AMERICAN MACHINIST.

Wanted—Worcester "Tech."; 3 yrs' shop exp.; 2 yrs. in drawing room, wishes pos. E. J. Q., 4 Wade St., Worcester, Mass.

First-class draftsman and designer wants position at once on regular or special work. Address Box 48, AMERICAN MACHINIST.

Sit'n by a 1st-class toolmaker; exp'd on jigs, fixtures and fine special mach'y; have had charge of works; also fair draftsman. Box 49, AMER. MACH.

Wanted—Position as assistant draftsman, 10 years' shop and 4 years' drafting room experience. Address Box 52, AMERICAN MACHINIST.

Foreman pattern maker, age 32, thorough in all its branches, desires situation with first-class concern; best of references. Foreman, AM. MACH.

Wanted—Position as engineer in electric plant by a practical all round mach. and toolmaker. Chas. A. Tuck, 30 Ceader St., So. Norwalk, Ct.

Graduated mech. engineer with 7 years' experience in shop and drafting room wants pos'n as assistant sup't or draftsman. Box 45, AM. MACH.

Wanted position as sup't or foreman by machinist and toolmaker; large exp. in tool and dynamo building. Address Box 46, Simsbury, Conn.

A mechanical engineer who can design machinery and handle men would like a Western position. O. H. I. O., AMERICAN MACHINIST.

Position as mechanical draftsman by technical graduate exp'd in water wheels, heavy power transmission & elect'l work. Box 53, AM. MACHINIST.

Wanted—Position as draftsman by young man with 3 years' shop and 3 years' drawing-room experience. Box 32, AMERICAN MACHINIST.

A mech. eng'r., capable of laying out plants & making estimates, desires to obtain in N. Y. City the agency from a reliable manufact'r of steam engs., boilers, etc.; cor. solicited. Box 34, AM. MACH.

Wanted—Position by thor'ly competent foundry foreman on high grade work; green or dry sand; engine, machinery or chilled rolls; references. Address "Chilled Rolls," AMERICAN MACHINIST.

Wanted—A salesman for machinists' tools and supplies; must have a good trade following; no attention will be paid to applicants not having above qualifications. Address Salesman, AM. MACH.

Shop agents for Carr's surface gauge and key rule clamps; liberal discounts; send for circulars; 2,000 gauges sold in past six months. The Hoggson & Pettis Mfg. Co., New Haven, Conn.

Wanted—Young man with experience in designing vertical engines, compound and triple expansion; steady employment and a good opening for advancement to the right man. Address with age, exp., and wages expected, Box 36, AM. MACHINIST.

A young man who has worked his way from apprentice to superintendent, with no influence except ability and attention to business, is thoroughly practical, expert on Corliss engs. and heavy machinery, desires a situation. Box 37, AM. MACH.

A young mechanical and steam engineer would take charge of large steam plant as chief engineer; a thorough draftsman and machinist, experienced in handling large engines and boilers, testing, indicating, etc. Box 51, AMERICAN MACHINIST.

Young mech. eng'r & draftsman, Jun. A. S. M.E., is open for engagement, exp'd on mach. tools, spec. mach'y & gen'l eng'g, solicits correspond'e from a suit. mach. shop in N. Y. or B'klyn; willing to undertake the developm't & manuf'e of cent'l pumps & hy'd work; prac. & ener. man. Reynolds, AM. MACH

Member of A. S. M. E. will be open to engagement after Sept. 1st; well equipped to superintend construction of machinery or as designer on machine tools, engines and general machinery; well posted on modern methods and appliances; is also a thorough mechanic. Box 47, AMER. MACHINIST.

Wanted—Business manager for a manufacturing company employing several hundred men on small fine machinery such as small arms and sewing machines; must be a thorough mechanic as well; good salary will be paid to one who has made a record. Address Duplan, AMERICAN MACHINIST.

Wanted—About Sept. 1st, position as chief draftsman or assistant to supt., by young and progressive mechanical engineer; theoretical and practical experience as machinist, draftsman, and chief draftsman and designer; 9 years' exp. in leading shops of the U. S. on tools, steam engineering, mining, transmission mach'y. Box 50, AM. MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

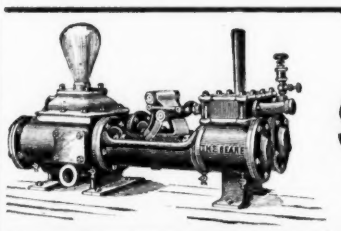
Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Rubber, metal and composition patterns for carding & grouping; small rubber & metal work to order. John T. Usher, 116 E. 54th St., New York.

For sale, or to let on royalty, patent of hand drill illustrated on page 5 of this issue. Apply to J. W. Knapp, Cross River, N. Y.

Machinist has $1,500 with services to invest in a well-paying machine shop, general or a specialty; can handle men and tools to advantage. Address C., 144 Union St., Brooklyn, N. Y.

We will pay 50 cents each for copies of the AMERICAN MACHINIST of December 4, 1886 issue, must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.



THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

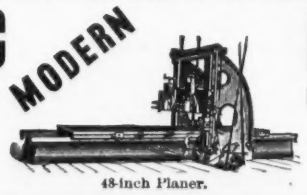
CRESCENT STEEL CO.
PITTSBURG, CHICAGO, NEW YORK.
STEEL FOR Lathe and Planer TOOLS, Cold Chisels, Punches & Dies, Milling Cutters, Molding Bits, &c.
SHEET STEEL, POLISHED Drill Rods, SPRING STEEL, Machinery Steel, COILED SPRINGS, Steel Forgings, ETC.

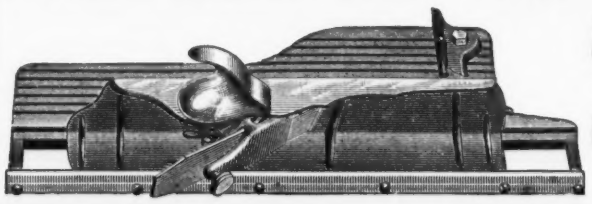
A NEW SCREW PLATE.

THE HANDIEST PLATE MADE.
THE FULL MOUNTED LIGHTNING.
These Plates have a stock with each die. The dies are our celebrated Adjustable **Lightning** Dies. Each Stock is of correct length and weight to suit size of die. Several sizes of dies may be in use out of same set at same time. SEND FOR CATALOGUE. Made by
WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

"R. MUSHET'S SPECIAL STEEL"
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES,
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St. NEW YORK: 143 Liberty St.

SEBASTIAN LATHE CO.
117 & 119 Culvert St., Cincinnati, O.
Manufacturers of Foot and Power
ENGINE AND SPEED LATHES,
For General Machine and Jobbing Shop, Electrical and Experimental Work.
DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

FITCHBURG MACHINE WORKS,
MANUFACTURERS OF THE CELEBRATED
FITCHBURG AND OTHER MODERN ENGINE LATHE

48-inch Planer.
METAL-WORKING MACHINES,
SEND FOR CATALOGUE E.
FITCHBURG, MASS.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.

A. J. WILKINSON & CO.
180 to 188 WASHINGTON ST.,
BOSTON, MASS.
SEND FOR CIRCULAR.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.

FRICTION AND LOST WORK IN MILLWORK MACHINERY.
By R. H. THURSTON,
3d Edition, - 8vo, - Cloth $3.00.
JNO. WILEY & SONS, NEW YORK.

MONEY SAVED.

COMBINED DRILL AND COUNTERSINK FOR CENTERING LATHE WORK.
Size of body 3-10 in.; Drill ¼ in. and 3-32, or same size each end.
" " 15-64 in.; " 8-100 and 7-100.
" " 13-64 in.; " 1-16 inch. Price $1.50 per doz.
J. T. SLOCOMB & CO., Providence, R. I.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.
☞Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LD.
Established a century ago.

GRANT GEARS
Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St., Philadelphia, Pa.

NEW EDITION,
"THE STEAM ENGINE,"
By Daniel Kinnear Clark, C. E., M. I., M. E. &
A practical work on Modern Steam Practice, LOCOMOTIVES, MARINE, STATIONARY and PORTABLE ENGINES and BOILERS, valve gear, link motions, triple and quadruple expansion, fuels, &c., &c. 1,560 pages, 1,300 diagrams, and plates drawn to scale. 2 vols., half calf, $16.00. Sent to any address, carriage prepaid. Send for descriptive circular. VIRTUE & CO., 72 Bible House, New York.

CHAPLIN TRY AND CENTRE SQUARE.

CATALOGUE FREE.
STANDARD TOOL CO., Athol, Mass., U. S. A.
Manufacturers of MACHINISTS' FINE TOOLS.

EICKEN & CO.'S CRUCIBLE TOOL STEEL
HAGEN, WESTPHALIA, GERMANY.
SPECIAL No. 8, makes a fine finish on the hardest Rolls; Boss Cold Chisel Steel; High Grade Twist Drill, Tap, Punch, Reamer, Wood and Milling Cutter Steel and Blanks.
The HIGHEST QUALITY; Inducements to the Trade and large Users.
REPRESENTED BY EDW'D VORSTER } IMPORTERS & EXPORTERS. { MARKT & CO., Agts. 79-85 N. Moore St., New York.

QUALITY IS ALWAYS FIRST
considered in the manufacture of the goods of
The MASON REGULATOR CO., of BOSTON.
We do not pretend to compete in price with many, but if you can buy better goods of us, which will last, is it not economy in the end to pay a little more? You must know that a firm of established reputation cannot and will not depreciate the quality of its output in order to meet competitors' prices.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.

PROVIDENCE, R. I., U. S. A.

3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

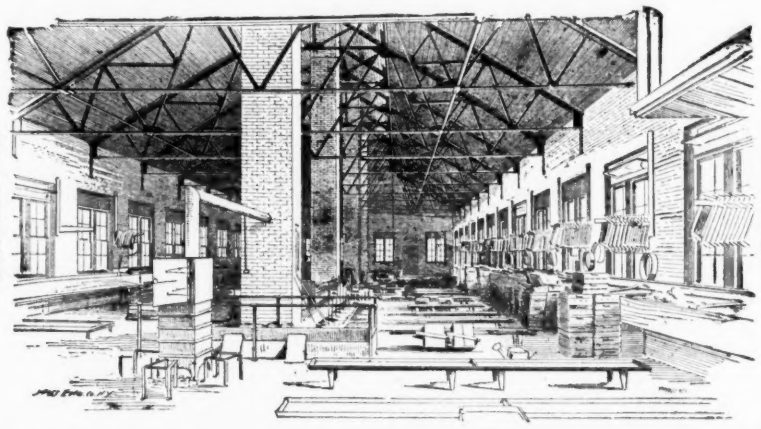
THE BERLIN IRON BRIDGE CO.

Office and Works:

No. 8 Railroad Ave., East Berlin, Conn.

CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

Engineers, Architects and Builders of



Iron and Steel Bridges and Buildings.

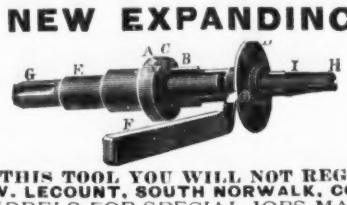
The above illustration is taken direct from a photograph and shows the interior construction of a Brass Foundry designed and built by us for Edw. Miller & Co., at Meriden, Conn. The building is 46 feet in width and 11: feet in length with an Iron Roof. Ventilation is secured by one of our Improved Ventilators on the ridge, with Corrugated Iron Shutters opening and closing by cords from the floor.

SEND FOR OUR ILLUSTRATED CATALOGUE.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.

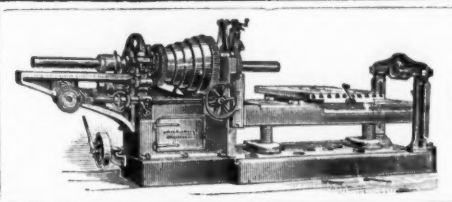
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.



Machinist's Size.

No.			Price.
1	⅛ to 1	in.	$10
2	1 "	1½ "	14
3	1½ "	2 "	18
4 (with screws)	2 "	3 "	32
5 " "	3 "	4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L't'd. 21 Cross St., London, England.

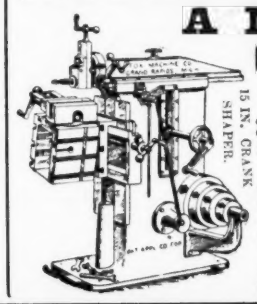


BETTS MACHINE CO.,
WILMINGTON, DEL.
MACHINE TOOL BUILDERS.
IMPROVED PATTERNS! LATE DESIGNS!
Chicago Office: 14 South Canal St.

ELECTRICON.

The Best Anti-Friction Metal in the World.
FOR ALL
MACHINE, RAILWAY AND MARINE BEARINGS.
HIGH QUALITY. LOW PRICE. SEND FOR SAMPLE.
UNION ELECTRIC COMPANY,
Manufacturers and Sole Agents, 45 BROADWAY, N. Y.

A NEW
CRANK SHAPER.
NOVEL, YET SIMPLE.
Length of stroke changed INSTANTANEOUSLY while IN MOTION.
Get Photos & Prices.
NOTHING LIKE IT.
Fox Machine Co.,
325 NOR. FRONT ST.,
Grand Rapids, Mich.
Chicago Office, Machinery Hall Annex, Section 13, Column J 43, World's Columbian Exposition.



Pat. KEY-SEAT SETTING GAUGE
PATENT UNIVERSAL SCREW-CUTTING CENTER
DEPTH ANGLE AND TWIST DRILL GAUGE
J. WYKE & CO
Fine Machinists' Tools. E. BOSTON, MASS. Send for LISTS

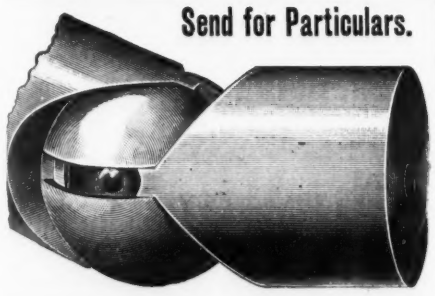
A SHEARING CUT
IS OBTAINED WITH OUR NEW
TOOL BLOCKS,
Also a faster feed can be used.
SEND FOR CIRCULAR.
HURLBUT-ROGERS MACHINE CO.,
SOUTH SUDBURY, MASS.

BUFFALO FORGES.

BUFFALO FORGE CO., BUFFALO, N. Y.

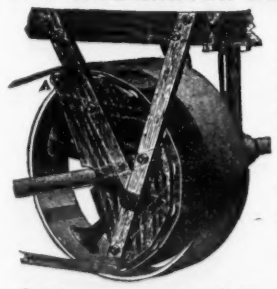
HEAT BUILDINGS BY
BOSTON HOT BLAST APPARATUS
Blowers and Exhausters for every duty—Dry Kiln Apparatus.
BOSTON BLOWER CO., Boston, Mass.

Send for Particulars.



THE STATES MACHINE CO.
HARTFORD, CONN.

THE WELLINGTON BELT HOLDER.



Cut shows Holder in position beside driving pulley.

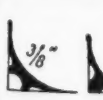
Large or small belts shifted from driving pulley and held at rest, and easily slipped back when machine is to be started.

It dispenses with loose pulleys, saves belts, and is perfectly safe.

It is *cheap*.

Write for descriptive circular and price list to

COOKE & CO.,
163 & 165 WASHINGTON STREET, NEW YORK,
And mention American Machinist.



Flexible Metallic Fillet
For Pattern Makers. 8 Sizes.
H. WHITE, 44 N. 4th St. Phila. Pa.

Machinists' and Boiler Makers' Tools,

NEW AND SECOND HAND.
(IN STOCK.)

Fitchburg Lathes, 14, 16, 18, 24, 30 and 36 in. swing.
Hendey " 14, 16 and 18 in., plain and taper.
Prentice " 15, 16 and 18 in., " " "
Improved " 24 in. x 10, 12, 14 and 16 ft. beds.
Powell Planers, 24, 30, 36 and 80 in. wide.
Improved Shapers, 15, 22 and 26 in. stroke.
Gould & Eberhardt 16 in. Crank Shaper. Latest.
Hendey 15 and 24 in. Stroke Friction Shapers.
Radial Drills, "new pattern," 3, 4 and 6 ft. arms.
Prentice Upright Drills. 20, 21, 25 and 32 in.
Universal and Plain Milling Machines. "improved."
Upright Boring and Turning Mills, 38 in. swing.

BOILER MAKERS' TOOLS.

Bending Rolls, 8 and 10 ft., "improved style."
Punch and Shear, 38 in. gap, "new pattern."
Plate Planers, 14 and 18 ft., "new pattern."
Hydraulic Riveting Outfit, 8 ft. gap, complete.

SPECIAL LIST—SECOND HAND.

Lathes, 13, 16, 20, 22, 26, 30 and 98 in. swing.
Planers, 15, 22, 24, 28 and 30 in. wide.
Shapers, 6, 8, 15 and 20 in. stroke.
Brown & Sharpe Vertical Turret Chucking Machine No. 2 size, A1 order.
Upright Boring and Turning Mill, 37 in. swing.
Screw and Milling Machines, several sizes.
National No. 3 Double Bolt Cutter, with dies, etc.
Keyseating Machine, portable and stationary.
Punch Presses, modern styles, A1 order.

J. J. McCABE,
SUCCESSOR TO
E. P. BULLARD'S
N.Y. Mach'y Warerooms,
14 Dey St.,
NEW YORK.

MUST BE SOLD AND REMOVED AT ONCE.

The Entire Equipment of the **United Electric Traction Company,** of Marion, N. J., comprising

31 Engine Lathes, from 14" to 48" swing.
15 Hand Lathes, from 10" to 20" swing.
5 Planers, from 24"x5' to 42"x12'.
6 Shapers, from 15" to 20" stroke.
13 Drill Presses, all sizes up to 32" swing.
8 Milling Machines, Plain and Universal.
2 Brown & Sharpe Screw Machines.
1 Large Newton Slotting Machine.
1 Large Radial Drill Press.
3 Gould & Eberhardt Automatic Gear Cutters, 36", 48", and 60".
1 Betts Machine Co. large Horizontal Boring Mill.
1 No. 2 Diamond Universal Grinding Machine.
2 Large Bliss Power Presses.
1-10 H. P. Baxter Engine, with 15 H. P. Boiler, complete, as good as new.

Also, Tool Grinders, Die Sinkers, Tapping Machines, Bolt Cutters, and large Pattern and Blacksmith Shop Equipments.

These tools are all in A1 condition and of the very best makes in this country. They will be sold at remarkably low prices, and must be disposed of at once.

Call at our salesroom and inspect them, or write for complete descriptive circular and price list.

THE GARVIN MACHINE CO.,
LAIGHT & CANAL STS., NEW YORK.

FOR SALE.

Second-hand 36 inch Eberhardt's Patent Automatic Gear Cutters, for cutting **Spur Gears** only, also for cutting Spur, Bevel and Worm Gears. All in A1 condition, being rebuilt at our own Works. These were taken in exchange for our new type. "Also No. 3 Baker Blower, good condition, only little used." Photos and full information write to

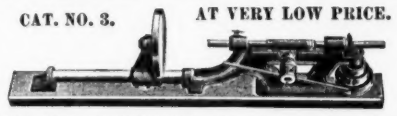
GOULD & EBERHARDT, Newark, N. J.

FOR SALE.
Ten Steam Yachts.

Now in use carrying passengers at the World's Fair, Chicago. Will sell and contract to deliver them afloat in any waters in the U. S. after close of the fair, November 1st. Two for immediate delivery. Licensed to carry 75 passengers each. The chance of a lifetime for anybody wanting a steam yacht. CHAS. P. WILLARD & CO., Clybourn and Southport Aves., Chicago, Ills.

A SPLENDID 16-INCH LEVER DRILL

CAT. NO. 3. AT VERY LOW PRICE.



THE GEO. BURNHAM CO., Worcester, Mass.

SECOND-HAND AND NEW MACHINERY

84x84x16½ ft. Planer. Niles Tool Works, three heads.

Planers.	62 in. x 22 ft.	Planers.	25 in. x 5 ft.
"	42 in. x 16 ft.	"	24 in. x 5 & 6 ft.
"	36 in. x 12 ft.		24 in. x 4 ft.
"	31 in. x 8 ft.	"	22 in. x 5 ft.
"	26 in. x 7 ft.		

80 in. x 18 ft. Engine Lathe Geared Face Plate.
60 in. x 45 ft. Double Engine Lathe.
52 in. x 35 ft. Engine Lathe Horizontal Boring Machine, one end.
30 in. x 28 ft. Pond Machine Tool Co. Shafting Lathe.
36 in. x 16 ft Engine Lathe.
33 in. x 27 ft. " "
32 in. x 12, 14, 16, 18 ft. Bed. New Engine Lathe.
28 in. x 32 ft. Engine Lathe, cheap.

25 in. x 12, 16, 20 and 24 ft. Bed.	New	do	do
21 in. x 10, 12 ft.	Bed.	do	do	do
20 in. x 5, 6, 8 & 12 ft.	do	2d Hand	do	do
18 in. x 6, 7 & 8 ft.	do	New &	do	do
17 in. x 8 ft.	do		do	do
16 in. x 6 & 8 ft.	do	do	do	do
15 in. x 6 & 8 ft.	do	do	do	do
14 in. x 6 ft.	do	do	do	do

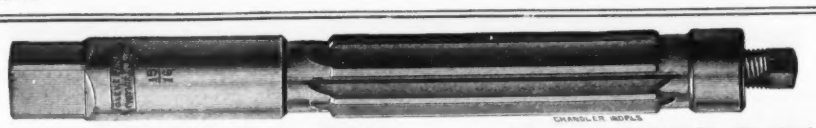
Car Axle Lathe, Bement. | Driving Wheel Lathe 88 in.
15, 16, 18, 25 in. Crank Shapers. | Wheel Quartering Mach.,
20, 24, 26 & 30 in. Geared Shapers. | Double right and left hand.
20, 22, 24, 28, 30 & 36 in. Drills. | No. 0 Turret Lathe,
Bolt Cutters. | Am. Tool and Mach. Co.,
8 an 1 13 in. Stroke Slotters. | 24 in. Swing, 8 ft. Bed.
Lot of Lincoln Pattern Millers and No. 1 P. & W. Millers.
4 Spindle Drills. Garvin.
Gear Molding Machine. Stamping Press, Bridgeport.
1100 and 3000 lb. Bement Steam Hammer.
100 lb. Steam Hammer. | SEND FOR
40 H. P. Vert. Engine. N. Y. S. S. P. Co. | MAY LIST.
11 in. x 18 in. Hor. Engine. A1 Order.
16 in. x 42 in. Corliss and 16 in. x 48 in. Brown Eng.
300 H. P. Westinghouse Comp'd Engine.

GEO. PLACE MACHINE CO.,
120 BROADWAY. NEW YORK.

WORTHINGTON STEAM PUMPS

FOR ALL DUTIES.

HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO,
ST. LOUIS, DENVER.

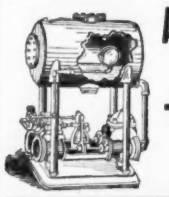


Established in 1874.
CLEVELAND TWIST DRILL CO.
Corner Lake & Kirtland Sts., Cleveland, O.
100 & 102 Reade Street, New York.
85 Queen Victoria St., London, Eng.

GRAHAM TWIST DRILL AND CHUCK CO., DETROIT, MICH., U. S. A.
SOLE MANUFACTURERS OF
GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

Now that **HOME TRADE** is dull
Buy Machine Tools that will enable you to
compete for **FOREIGN TRADE** successfully.
HEAVY TURRET LATHES, ETC.
Designed expressly for increasing your product
THE LODGE & SHIPLEY MACHINE TOOL CO.,
CINCINNATI, OHIO, U. S. A.



AUTOMATIC FEED PUMPS AND RECEIVERS
For returning hot condensed water to boiler.
STEAM PUMPS FOR ALL DUTIES.
THE BUFFALO STEAM PUMP CO.,
WORKS, BUFFALO, N. Y.
BRANCH OFFICES { 76 JOHN STREET, N. Y. CITY. 55-57 CLINTON STREET, CHICAGO, ILLS.

WYMAN & GORDON, WORCESTER, MASS.

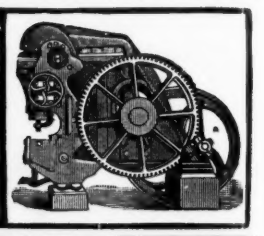
Drop Forgings.

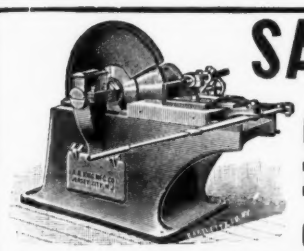
LELAND, FAULCONER & NORTON CO.
WET EMERY GRINDER.
Any amount of water easily applied without the use of Pump, Hose, Treadles, Cocks, or any of the objectionable features common in this class of Machine. Truing Device, which is inexpensive, does the work perfectly and quickly. The whole rig practically as simple as the old-fashioned grindstone trough and much more effective. Send for circular.
LELAND, FAULCONER & NORTON CO.,
96 TO 106 BATES STREET, DETROIT, MICH.

BROMFIELD-PEARSON TECHNICAL SCHOOL,
TUFTS COLLEGE, MASS.
Engineering Courses for Special Students.
For Further Information Address
GARDNER C. ANTHONY, DEAN.

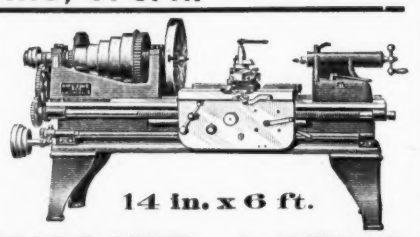
SOFT GRAY IRON CASTINGS.
From ½ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build.
ONTARIO IRON WORKS,
CANANDAIGUA, N. Y.

PUNCHING AND SHEARING MACHINERY
AND BOILER MAKERS ROLLS.
NEW DOTY MANUFACTURING CO.
JANESVILLE WISCONSIN.





SAW
FOR
Cutting Hot Iron or Steel.
A. R. KING MFG. CO.,
ERIE, 11th & 12th Sts.,
JERSEY CITY, N. J.
MACHINERY AND TOOLS.
Heavy Machine Castings.



14 in. x 6 ft.
ENGINE LATHE.
22 in. x 8 ft., 10 ft., 12 ft., 14 ft. x 16 ft.
LATEST IMPROVED
ENGINE LATHES.
Patent Radial Drills a Specialty.
ADDRESS
DIETZ, SCHUMACHER & CO.,
Successors to DIETZ, GANG & CO.,
58 & 60 PENN ST.,
CINCINNATI, O., U. S. A.

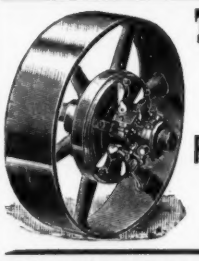
"PRACTICAL DRAWING."
By J. G. A. MEYER.
This valuable series of 93 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies, 5 cts. each, postpaid.

Order now before our stock of papers is exhausted.
ADDRESS:
American Machinist,
203 BROADWAY,
NEW YORK.

"MODERN LOCOMOTIVE CONSTRUCTION."
By J. G. A. MEYER.
This valuable series of 106 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $5.30 or single copies, 5 cts. each, postpaid.

STEEL BALLS

⅛" to 2" in stock; sizes to 4" to order.
Circular and Prices on Application.
Grant Anti-Friction Ball Co.
Fitchburg, Mass., U. S. A.

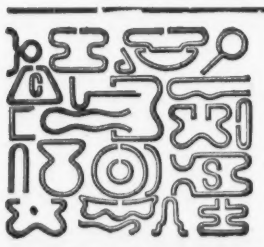


The Moore & White Co.,
15th St. & Lehigh Ave.,
PHILADELPHIA, PA.
MFRS. OF
The "Moore & White"
Friction Clutches
AND
Cut-off Couplings.
Send for Circulars.

PECK'S PATENT
DROP PRESS,
MANUFACTURED BY
MINER & PECK MFG. CO.,
NEW HAVEN, CONN.

MACHINE DESIGNING, MECHANICAL DRAWING,
Patent Office Drawing, Print Copies of all kinds and sizes. Lowest prices consistent with good workmanship. Correspondence solicited.
FRANK A. FOSTER,
Room 442 Butler Exchange, PROVIDENCE, R. I.

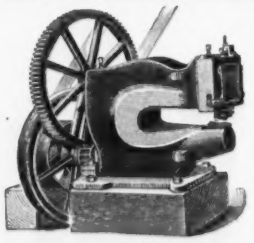
BICKFORD DRILL AND TOOL CO.
3 PIKE STREET, CINCINNATI, OHIO.
BUILDERS OF
UPRIGHT, RADIAL, HALF AND FULL UNIVERSAL RADIAL DRILLS.
BORING AND TURNING MILLS.



BLAKE & JOHNSON,
WATERBURY, CONN.
Builders of WIRE FORMING MACHINES
With F. B. Manville's Patent Sliding Former,
For making articles from the coil, of either round, half-round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.
Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.
☞ Bicycle and Labor Saving Machinery a Specialty.

WE GUARANTEE { The best designed / The best constructed / The smoothest running / The most economical / The most efficient } **BLOWER**
When requiring anything in this line write to
THE CONNERSVILLE BLOWER CO.
CONNERSVILLE, IND.

E. W. BLISS CO.,
1 ADAMS ST., BROOKLYN, N. Y.
Western Office, 14 N. CANAL ST., CHICAGO, ILL.



Punching and Drawing Presses, Drop Hammers, Dies, Shears and Special Machinery.
OWNERS OF
THE STILES & PARKER PRESS CO.

THE LEADER HACK SAW MACHINE
Perfect Allignment Of Blade.
Will cut STEEL at an angle.
Frame rises on return stroke, saving wear on blades.

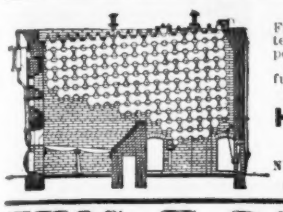
SEND FOR LIST.
THE FRASSE COMPANY,
19 Warren St., New York City.

BOSTON GEAR WORKS
35 HARTFORD ST., BOSTON, MASS.
GEARS, ALL KINDS, SMALL OR LARGE.
300 LIST IRON, 600 LIST BRASS
Catalogue FREE to any Business Firm.

POWER PRESSES
Adjustable. Improved.
FOR TIN, BRASS AND SHEET IRON WORKERS.
WORKMANSHIP GUARANTEED
STRONG AND DURABLE.
Send for Circulars.
SPRINGFIELD MACHINE TOOL CO.
SPRINGFIELD, OHIO.

Root's Force Blast Rotary Blower.
FOR
FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.
Best Mechanical Construction.
P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.
S. S. TOWNSEND, Gen. Agt. } 163 & 165 Washington St.
COOKE & CO., Selling Agts. } NEW YORK.
In Writing Please Mention This Paper.



Absolute Safety from Destructive Explosion—Highest Attainable Economy of Fuel - Rapid Generation of Dry or Superheated Steam—Durability—Low Cost of Maintenance—Ease of Transportation and General Efficiency are among the advantages possessed by the "Wharton-Harrison" form of boiler.

Send for Descriptive Pamphlet—Drawings, Specifications, and Estimates promptly furnished for any amount of power from 4 H P. up.

State requirements and consider our proposition.

HARRISON SAFETY BOILER WORKS,

PHILADELPHIA, PENNA.

NEW YORK, N. Y. 41 Dey Street. | CHICAGO, ILL. 187 La Salle Street. | ATLANTA, GA. 9 No. Pryor Street.

THOS. H. DALLETT & CO.,

York Street & Sedgley Ave., Philadelphia.

Manufacturers of

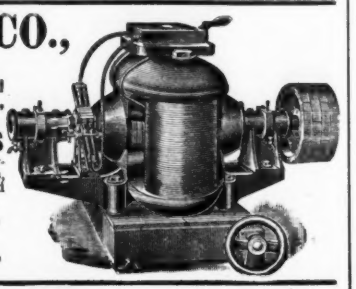
Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses.

ELECTRIC MOTORS

Specially adapted for driving Machine Tools, Cranes, Elevators, Pumps, Presses and other Machinery.

ELECTRIC GENERATORS,

For installation of Complete Power Plants.

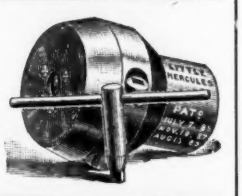


THE ONEIDA MFG. CHUCK CO.,

ONEIDA, N. Y., U. S. A.

MANUFACTURERS OF PATENTED

LATHE AND DRILL CHUCKS.



THE LITTLE HERCULES DRILL CHUCK, combines in its gripping mechanism three unequaled principles known in the field of mechanics, namely, the eccentric, lever and screw. In their combination and relative proportion in this tool we are enabled to offer a much superior tool, guaranteed to meet the claims we make for them. **Write for Catalogue.**

Norton Emery Wheel Co.

SEND FOR ILLUSTRATED CATALOGUE

Worcester, Mass.

CRANES TROLLEYS, PORTABLE HOISTS, OVERHEAD TRACK.

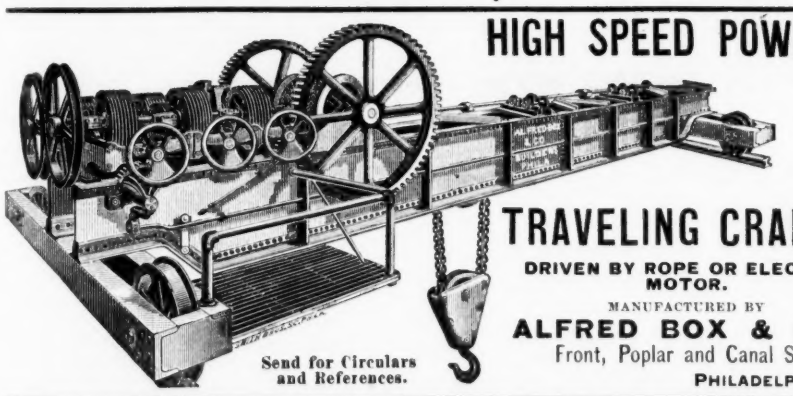
WORLD'S FAIR, Machinery Hall, Section 26, Column O. 30.

SEND FOR CATALOGUE.

MARIS AND BEEKLEY,

2343 & 2345 Callowhill St., PHILADELPHIA, PA

HIGH SPEED POWER



TRAVELING CRANES.

DRIVEN BY ROPE OR ELECTRIC MOTOR.

MANUFACTURED BY

ALFRED BOX & CO.,

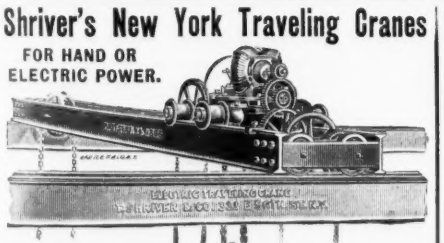
Front, Poplar and Canal Sts.

PHILADELPHIA, PA

Send for Circulars and References.

Shriver's New York Traveling Cranes

FOR HAND OR ELECTRIC POWER.



T. Shriver & Co. 333 East 56th St., NEW YORK.

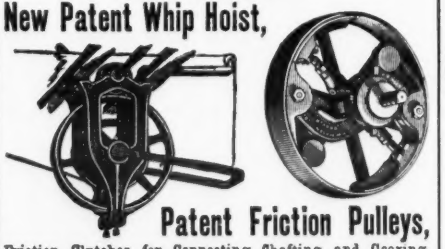
MANUFACTURERS OF

TRAVELING CRANES of 1½, 2, 3, 5 and 10 Tons capacity, to be operated by Hand, or **wholly** or **in part** by Electricity.

VOLNEY W. MASON & CO.,

MANUFACTURERS OF

New Patent Whip Hoist,



Patent Friction Pulleys,

Friction Clutches for Connecting Shafting and Gearing.

PROVIDENCE, R. I., U. S. A.

TRUMP CHUCK.

The Cheapest and Best.

WILL HOLD ACCURATELY, STRAIGHT or TAPER Shank Drills.

Write for Prices to

TRUMP BROS. MACHINE CO., MFRS.

Wilmington, Delaware, U. S. A.

For Sale by CHAS. CHURCHILL & CO., Ltd.

21 Cross Street, Finsbury, London, England.

Made in 3 sizes, viz.: No. 1. Holds 0 to 1/8"
" 2. " 0 to 1/4"
" 3. " 0 to 3/8"

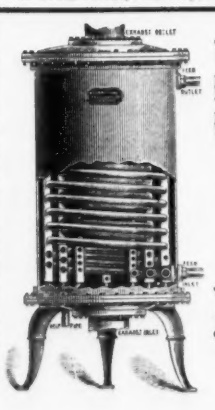
The Sample Tells the Story.

A sample of Dixon's pure, flake lubricating Graphite, with interesting and instructive pamphlet,

Sent free of charge.

JOS. DIXON CRUCIBLE CO.,

JERSEY CITY, N. J.



The National Feed-Water Heater

A brass coil Heater delivering water to the boiler at 210° Fahrenheit.

500,000 H. P. sold. Prices low. Satisfaction universal.

The National Pipe Bending Co.

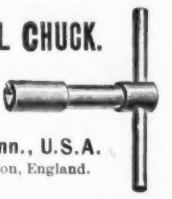
82 River St. New Haven, Ct.

Ask your nearest Dealer, or send to the Manufacturers for

THE LATEST AND THE BEST TWO JAW DRILL CHUCK.

Strong, Accurate, Durable, Cheap.

Made entirely of Steel, Body Solid, of but one piece of Metal.



Ask for Style B.—Holds from the smallest to ½ inch.

THE E. HORTON & SON CO., Windsor Locks, Conn., U.S.A.

or, CHAS. CHURCHILL & CO., Ltd., 21 Cross St., Finsbury, London, England.

N.B.—See Exhibit at World's Fair, Section 29, Column K, Machinery Hall.

NOTICE

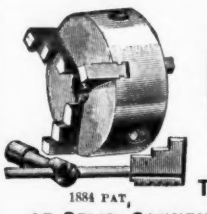
We have just added to our line of patent Face-Plate Jaws an 8 inch. We now carry in stock three sizes—8 inch, 10 inch and 12 inch.

Send for new Catalogue of Chucks to

THE CUSHMAN CHUCK CO.,

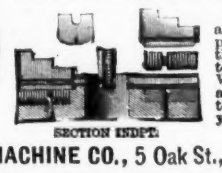
HARTFORD, CONN.

LATHE AND DRILL CHUCKS.



1884 PAT.

FEQ DRILL.



SECTION DEPT.

Buyers should note quality first and then price. We have made improvements which greatly increase the durability and accuracy of our tools. Please investigate our claims. We carry a large variety in stock and design chucks and chucking tools for special purposes. Have you read our late catalogue?

THE D. E. WHITON MACHINE CO., 5 Oak St., New London, Conn., U.S.A.

OR SELIG, SONNENTHAL & CO., 85 QUEEN VICTORIA ST., LONDON, E. C., ENGLAND.

CHUCKS

ALL STYLES. NEW REVERSIBLE JAWS (DOVETAILED).

New Catalogue Now Ready.

THE HOGGSON & PETTIS MFG. CO.,

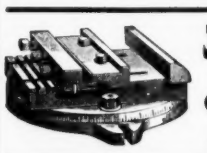
Est. 1849. NEW HAVEN, CONN.

Chucks The NATIONAL. INDEPENDENT, UNIVERSAL, COMBINATION.

Strongest. Easiest to change. Best finish. **Reversible Jaws** (patented) giving 5 changes including every possible desired position. NEW CATALOGUE, illustrated, sent free. Liberal discounts. Prompt shipment. Address

WM. WHITLOCK, MANUFACTURER,

132d Street and Park Ave., New York City.



Jordan Planer Chucks.

SEND FOR CIRCULAR.

C. W. JORDAN,

4 Wayne St., WORCESTER, MASS.

Cranes

CUPOLAS, LADLES, TRUCKS,

Detroit Foundry Equipment Co.,

702 TEMPLE COURT, CHICAGO | DETROIT, MICH.

SOFT CASTINGS,

Made from best grades of Pig Iron for Light Machinery, Electric Work, etc.

THE BURR & HOUSTON CO.,

33 TO 39 FRANKLIN ST., BROOKLYN, N. Y.

KEUFFEL & ESSER CO.

NEW YORK

Branch: 265 State St., Chicago.

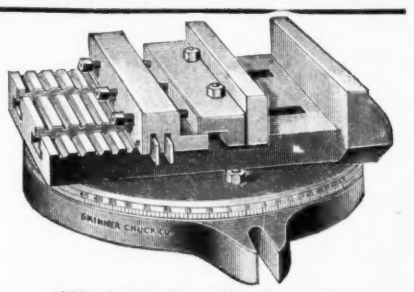
Manufacturers of

Drawing Materials, Surveying Instruments, &c.

Paragon Drawing Instruments, Extra and Best Quality; German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing Helios, Blue Process Papers, Scales, Triangles, T-Squares &c., &c. Catalogue on application. At Columbian Exposition: Liberal Arts Building, Section E. M. 103.

ANY COMPANY

contemplating the expenditure of a large amount in the establishment of a manufacturing industry, requiring the use of a thoroughly equipped Machine shop, Boiler shop, Foundry and Smith shop plant, well located on competing trunk lines of railroads and in a good labor market, is invited to address, **STIMSON, WILLIAMS & CO., Bryant Building, 55 Liberty St., New York.**



IMPROVED PLANER CHUCKS,

Independent, Universal and Combination **Lathe** Chucks, **Drill** Chucks, **Cutting-off** Chucks, and **Face-plate** Jaws.

THE SKINNER CHUCK CO., New Britain, Ct., U.S.A.

Write **The Pratt Chuck Co.,** Clayville, N. Y., U. S. A., for free illustrated catalogue of

POSITIVE DRIVING DRILL CHUCKS,

made in eleven sizes and two styles, showing the only perfect system ever devised for holding and driving drills.

FOREIGN AGENCIES:

Ph. Roux et Cie, 54 Boulevard du Temple, Paris, France; E. Sonnenthal, Jr., Nueu Promenade No 5, Berlin, Germany; Selig, Sonnenthal & Co., 85 Queen Victoria St., London, E. C., England.

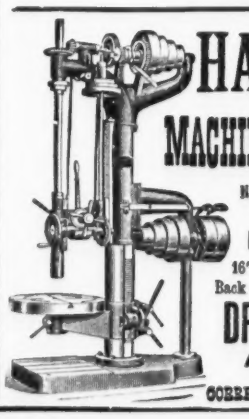
THE MERRELL MFG. CO.

Cor. Curtis and Charles St., TOLEDO, OHIO,

Manufacture The Best and Most Complete Line of Hand And Power

PIPE THREADING MACHINERY IN USE.

Send for Catalogue.



HAMILTON MACHINE TOOL CO.,

N. E. Cor. Water & Market Sts., Hamilton, Ohio, U. S. A.

MODERN

16", 22", 26", 32" and 36"

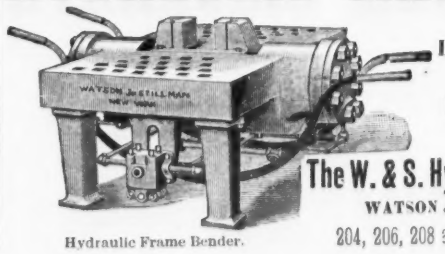
Back Geared and Power Feed

DRILL PRESSES

A SPECIALTY.

CORRESPONDENCE SOLICITED.

HYDRAULIC MACHINERY,



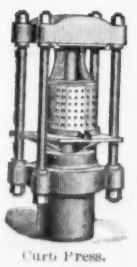
Hydraulic Frame Bender.

PRESSES, PUMPS, PUNCHES, JACKS, VALVES, FITTINGS, PACKINGS, ACCUMULATORS.

The W. & S. Hydraulic Machinery Works,

WATSON & STILLMAN, Proprietors,

204, 206, 208 and 210 East 43d St., NEW YORK.



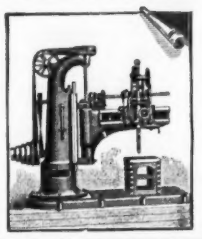
Curb Press.

PUTNAM MACHINE COMPANY,

ORIGINAL BUILDERS OF

Fitchburg Lathes, Planers, Drills, Machine Tools.

AND AUTOMATIC CUT-OFF STEAM ENGINES.



Fitchburg, MASS., U. S. A.

ESTABLISHED 1836.

ELECTRIC CRANES AND TOOLS.

PAWLING & HARNISCHFEGER, BUILDERS,

MILWAUKEE, WIS.

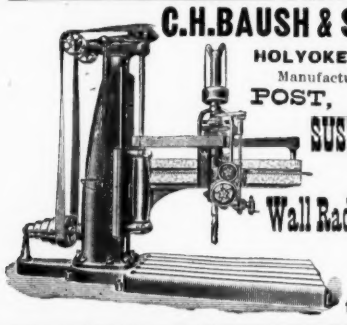
C.H.BAUSH & SONS,

HOLYOKE, MASS.

Manufacturers of

POST, SUSPENDED AND Wall Radial Drills

From the smallest to the largest.

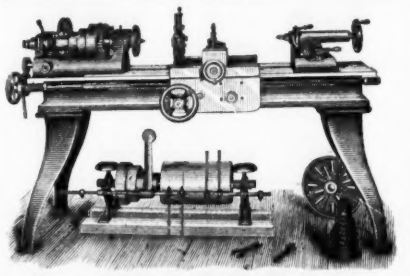


ARE YOU DRIFTING

into conventional ruts? If you are you had better get out of them. In looking for business you must strive for all good things. Here's where you will be reminded of our MACHINE MOLDED gear wheels, made from a SPECIAL PROCESS charcoal iron. They are better than a good thing.

UNION FOUNDRY & MACHINE CO.,

PITTSBURGH, PA.



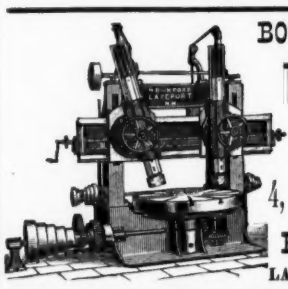
A. FALKENAU,

11th Street & Ridge Ave., Philadelphia, Pa.

MANUFACTURER OF

SUPERIOR 14 INCH LATHES, TOOL GRINDING MACHINERY, TRAVELING CRANES, ETC.

Special Machinery designed and constructed.



BORING AND TURNING MILLS,

4, 5, & 6 ft. Swing

H. Bickford,

LAKEPORT, N. H.

Stover Power Hack Saw.

Cuts off any Size or Shape of Metal UP TO 4½ INCHES.

No skill required to run it. When bar is cut off the machine automatically lifts the saw from the work and stops.

The pressure on the saw is *much greater on the forward stroke* than on the return.

This is the Most Practical Machine for the Purpose ever offered to the trade.

No shop can afford to be without it.

Satisfaction Guaranteed.

Price, $25.00.

STOVER NOVELTY WORKS,

23 RIVER ST., FREEPORT, ILL.

EVERY MACHINIST SHOULD HAVE A COPY OF

OUR CATALOGUE.

It is a 704 page cloth bound book. A copy will be sent, express paid, to any one sending $1.00, and the money paid for book will be refunded with first order amounting to $10.00 or over.

MONTGOMERY & CO.,

105 FULTON STREET. NEW YORK CITY.

W. C. YOUNG M'F'G CO., WORCESTER MASS.

Foot Lathes, Engine Lathes,

SHEARS AND PUNCHES.

THE GARVIN MACHINE CO.,

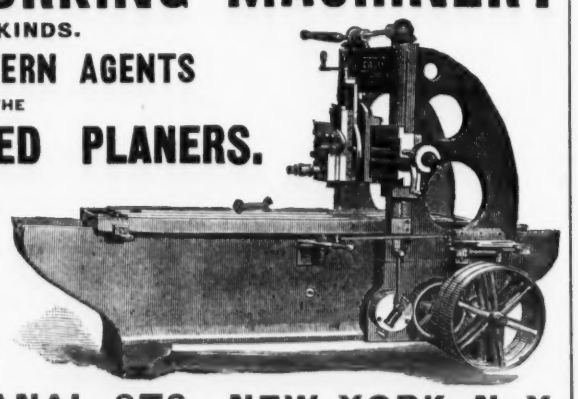
MANUFACTURERS OF AND DEALERS IN

METAL WORKING MACHINERY

OF ALL KINDS.

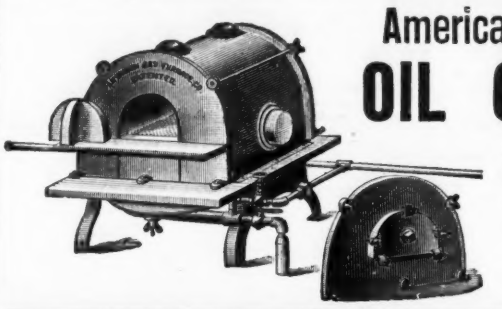
GENERAL EASTERN AGENTS FOR THE

GRAY DEEP BED PLANERS.



Lathes, Shapers, Drills, Plain and Universal Milling Machines, Screw Machines, Turret Lathes, Grinding Machinery, Hand Lathes, Profilers, Tapping Machines, &c.

LAICHT and CANAL STS., NEW YORK, N. Y.



American Gas Furnace Co.,

OIL GAS PLANTS

AND

GAS BLAST FURNACES.

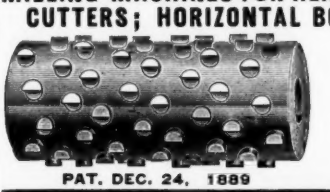
Send for Catalogue. Estimates made for any mechanical operation requiring **high, even and controllable temperature.**

No. 80 NASSAU STREET, NEW YORK.

THE INGERSOLL MILLING MACHINE CO.,

ROCKFORD, ILL., U. S. A.

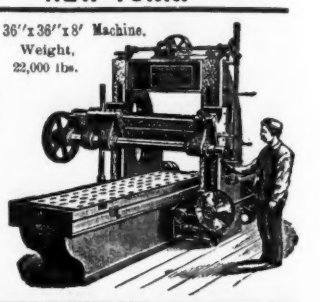
MILLING MACHINES FOR HEAVY WORK; MILLING CUTTERS; HORIZONTAL BORING MACHINES.



PAT. DEC. 24, 1889

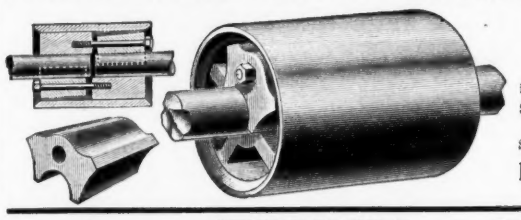
SIZES.

15″X15″X4′
22″X22″X5′
24″X24″X6′
36″X36″X8′



36″x36″x8′ Machine. Weight, 22,000 lbs.

NO KEYS. NO KEY-SEATING. NO SLIPPING. STUART'S PATENT



Compression Wedge Coupling.

SENT ON TRIAL.

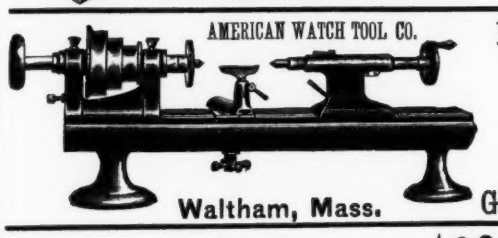
Can be attached or removed in a few seconds without injury to shaft or coupling.

SIMPLEST and BEST in MARKET, Also the Cheapest.

Send for discount and illustrated Price List of 20 sizes.

R. J. STUART'S FOUNDRY AND MACHINE WORKS, NEW HAMBURGH, N. Y.

AMERICAN WATCH TOOL CO.



Waltham, Mass.

LATEST IMPROVEMENTS.

NEW STYLE.

NEW PRICES.

GROWING RAPIDLY in FAVOR

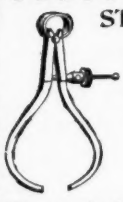
P. BLAISDELL & CO.,

Manufacturers of

Machinists' Tools,

WORCESTER, MASS.

STARRETT'S



FINE TOOLS

Warranted Accurate—Best in Workmanship—Latest in design—Finest in Finish—Send for Catalogue.

L. S. STARRETT,

Athol, Mass., U. S. A.

LONDON AGENTS: Chas. Churchill & Co., Ltd., 21 Cross St., Finsbury, E. C.

Nonpareil Ratchet Wrenches.

Made of best forged Tool Steel; are easily and readily adjusted and controlled. Can be made reversible instantly without removing from their work by throwing over the lever in slot of the handle.

The Set of Combination Tools No. 1 includes the wrench, two sockets, one for screw-driver, bit or reamer shank, with wood handle and one socket for drill shank and feed nut. The jaws on this wrench open from ⅛ to 1¼ inches.

Send for Illustrated Circular and Price List of various sizes.

The Keystone Manufacturing Co.,

312 TERRACE, BUFFALO, N. Y.

Something New in Mechanics.

GEOMETRIC

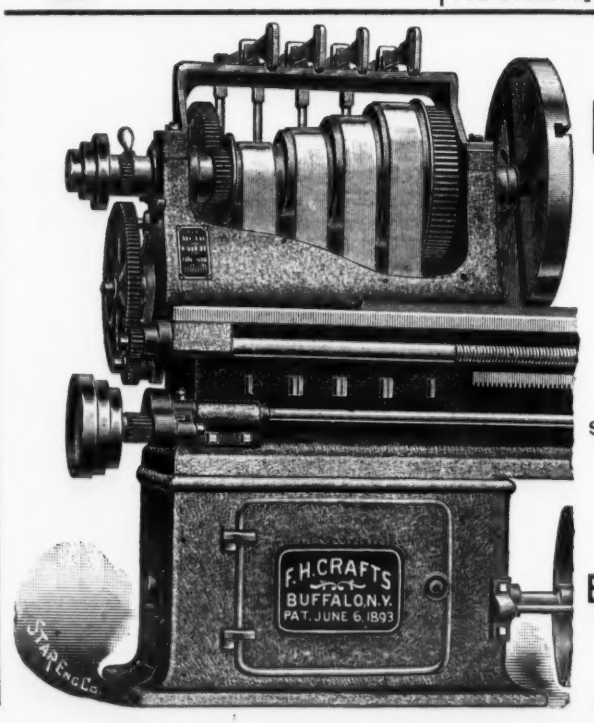
BORING & TURNING TOOL.

An attachment to a drill press for boring any geometrical figure, such as round, square, hexagon, etc.

For particulars and prices address,

A. T. SHOEMAKER,

115 Broadway, - NEW YORK CITY.



F. H. CRAFTS' DRIVING DEVICE

FOR

Engine Lathes, and all other Iron Tools employing Cone Pulleys, including Planers.

PATENTED JULY 6th, 1893.

Send for Prices and Descriptive circulars.

ADDRESS:

F. H. CRAFTS,

CARE

BUFFALO WOODWORKING MACHINE CO.,

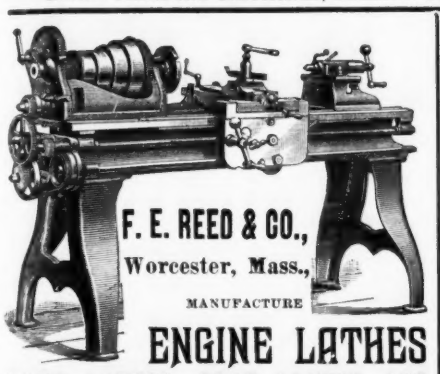
COR. HUDSON & 7th STS.,

BUFFALO, N. Y.

MORSE TWIST DRILL AND MACHINE COMPANY,

Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



F. E. REED & CO.,
Worcester, Mass.,
MANUFACTURE
ENGINE LATHES
HAND LATHES, FOOT LATHES AND MILLING MACHINES.
Manning, Maxwell & Moore,
Selling Agents, 111 Liberty St., New York.
515 Phenix Building, Chicago.

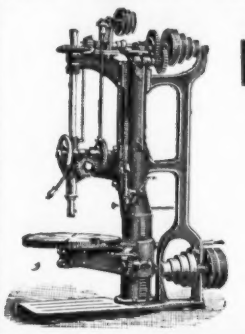
2 BY 24 FLAT TURRET LATHE.

Send for CATALOGUE for '92.
JONES & LAMSON MACHINE CO.,
Springfield, Vt., U. S. A.

Back Volumes of the AMERICAN MACHINIST for 1880, '82, '83, 84, '85, '87, '88, '89, '90, '91 and '92.
A FEW MAY STILL BE HAD.
Address AMERICAN MACHINIST, 203 Broadway, N. Y

NEW HAVEN MANUF'G CO.,

New Haven, Conn.



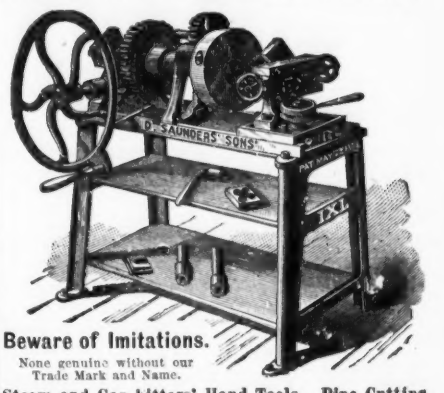
Lathes, Planers, Shapers, Slotters, Etc.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO
WORCESTER, MASS.
Manufacturers of Set, Cap & Machine Screws, Studs, etc.

VERTICAL DRILL PRESSES, 12 to 52 inch swing. Radial Drills, 4 to 10 ft. swing. Boiler Makers' Drills, Bridge and Ship Builders' Drills, Gang Drills, and other Drilling Machinery. Engine Lathes, 12 to 24 in. swing. Send for Catalogue.
PRENTICE BROS.,
WORCESTER, MASS.

D. SAUNDERS' SONS

MANUFACTURERS OF THE ORIGINAL
TRADE I. X. L. MARK.
PIPE CUTTING & THREADING MACHINE



Beware of Imitations.
None genuine without our Trade Mark and Name.
Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.
SEND FOR CIRCULAR.
21 Atherton St., YONKERS, N. Y.

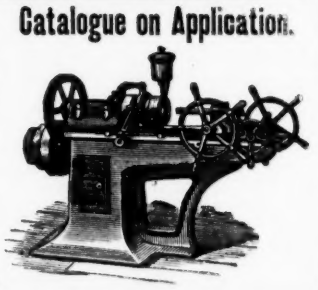
FOR
Substantial, Well Made, Low Price, Patented,
20 Inch Drills,
With latest improvements, Lever, Combination or Wheel Feed, address
Sibley & Ware,
SOUTH BEND, - INDIANA.

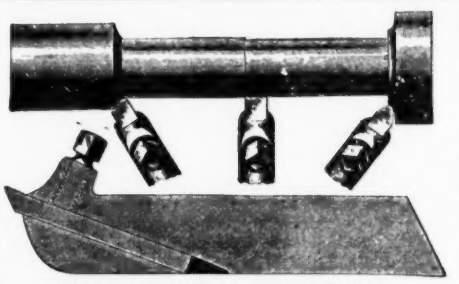
The Cincinnati Milling Machine Co.
MILLING MACHINES
Modern Design, New Features, High Class Workmanship
UNIVERSAL CUTTER & REAMER GRINDERS.
Cincinnati, O.
Send for Catalogue

Bolt and Nut Machinery.

Catalogue on Application.

Complete Outfits for Bolt and Car Shops.
Bolt Cutters, Bolt Pointers,
Upsetters and Benders,
Bolt Headers, Nut Tappers,
Nut Machines,
Washer Machines, Car Link and Pin Machinery.
The National Machinery Co., Tiffin, O.





FOR GENERAL LATHE AND PLANER WORK.

ARMSTRONG TOOL HOLDER.

Patent Feb. 28, 1893.

A solid steel forging, case-hardened Tool Steel Set Screw. Self hardening steel cutters. Saves forging, 70 per cent., grinding 90 per cent. Tool Steel.

Over 5,000 already in use.

For Sale by all First-class Dealers.

Foreign Agency, CHAS. CHURCHILL & CO., Ltd., London, England.

Made in 7 sizes, from ¾" x ¾" x 5" to 1¼" x 1⅞" x 12".

MANUFACTURED ONLY BY
ARMSTRONG BROS. TOOL CO.,
78 Edgewood Ave., Chicago, Ill.

Liberal Inducement to Agents.

SLIDING CALIPERS in all styles and graduation, plain and with CLAMP AND SCREW ADJUSTMENT. Small Micrometers, Fine Steel Squares, Surface Gauges, Etc.

In use at some of the *leading Schools, Universities, etc.*, who are *well pleased with them* owing to *their superior quality* and *low prices*. Ask your dealer for them, or send for new circulars with prices, to
E. C. SMITH, COLUMBIA, PA.

MACHINERY

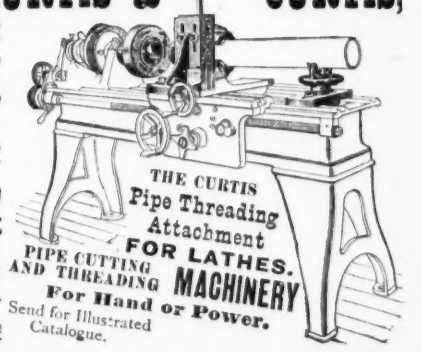
For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or Information address the Manufacturer,
S. W. GOODYEAR, Waterbury, Conn.

American Standard Gauge & Tool Works,
WILMINGTON, DEL.
Makers of Implements for Standard Measurements.

Over 52,300 in Use
Crescent Gauge. Flat Bar Gauge.
Send for New Pamphlet. JAS. A. TAYLOR & CO.

CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



THE CURTIS Pipe Threading Attachment FOR LATHES.
PIPE CUTTING AND THREADING MACHINERY
For Hand or Power.
Send for Illustrated Catalogue.

BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines,
Drilling Machines,
Bolt Cutting Machines.
CHAS. CHURCHILL & CO., Ltd,
21 Cross St., Finsbury, London.

BARKER'S IMPROVED CENTER GRINDING MACHINE.

NO GAUGES. NO BELT.
Every Machine Guaranteed.
MANUFACTURED BY
WM. BARKER & CO., Cincinnati, Ohio.
SEND FOR CIRCULAR.

MACHINISTS' SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

MECHANICAL DRAWING TAUGHT BY MAIL

Also, MECHANICS, *Mining, Prospecting, Arithmetic, etc.* To begin, students only need know how to read and write. DIPLOMAS Awarded. Low Prices. Send for FREE Circular to
THE CORRESPONDENCE SCHOOL OF MECHANICS, SCRANTON, PA.

SMALL CRANKS AND ENGINE PARTS MADE.

W. D. FORBES & CO.,
HOBOKEN,
N. J.
1300 HUDSON STREET.

MILLING CUTTERS,
FINE TOOLS,
SPECIAL MACHINES,
HARDENED ARBORS.

Maule's "Skeleton" Pipe Die

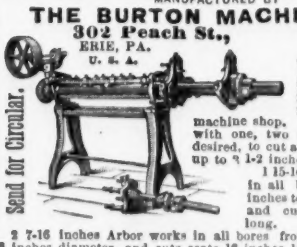
is Manufactured by HENRY B. PANCOAST & CO., Philadelphia, U. S. A.

is a **Skeleton** *in construction, a* **Giant** *in efficiency, an* **Infant** *in price.*

Ask your jobber for full particulars of it, and if he cannot give you the desired information, we shall be most happy to do so. If you use any Pipe Dies, this one is a tool far too good and cheap for you not to know all about it.

THE ERIE KEY-SEATING MACHINE.

MANUFACTURED BY
THE BURTON MACHINE CO.,
302 Peach St.,
ERIE, PA.
U. S. A.



Send for Circular.

The cut represents our Stationary and Portable Key-Seating Machine, which fully meets all the requirements of a machine shop. They are furnished with one, two or three Arbors as desired, to cut any width of key-seat up to 3 1-2 inches wide.

1 15-16 inches Arbor works in all bores from 1 15-16 inches to 3 inches diameter, and cuts seats 12 inches long.

2 7-16 inches Arbor works in all bores from 2 7-16 inches to 8 inches diameter, and cuts seats 16 inches long.

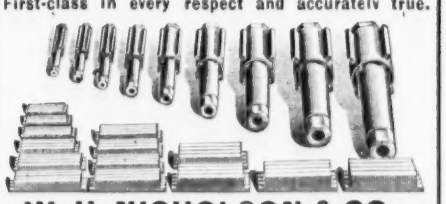
4 7-16 inches Arbor works in all bores from 4 7-16 inches to 14 inches diameter, and cuts seats 25 inches long.

With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.

If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

NICHOLSON'S EXPANDING MANDRELS,

MADE OF BEST STEEL—HARDENED AND GROUND.
First-class in every respect and accurately true.

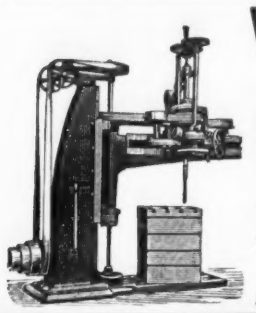


W. H. NICHOLSON & CO.,
MANUFACTURERS OF
MECHANICAL SPECIALTIES,
WILKES BARRE, PA.

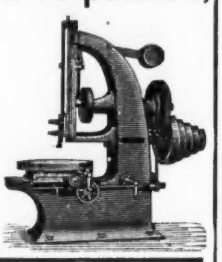
BARNES' WATER EMERY TOOL GRINDER

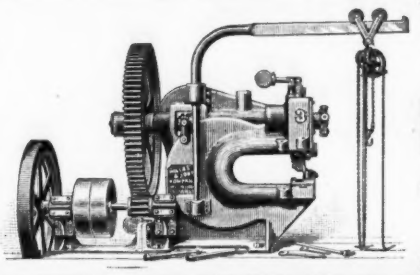
Has no pumps, no valves. No piping required to supply it with water. Always ready for use. Simplest in construction, most efficient in operation. Send for Catalogue and Prices.

W. F. & John Barnes Co.
1995 RUBY ST.,
ROCKFORD, ILL.
ENGLISH AGENTS,
CHAS. CHURCHILL & CO., LTD.
21 CROSS ST., FINSBURY, LONDON, E. C., ENG.



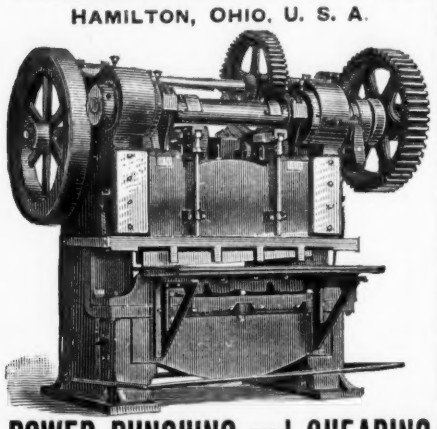
WM. SELLERS & CO., Incorporated,
PHILADELPHIA, PA.
MANUFACTURERS OF
MACHINE TOOLS,
TRAVELING CRANES AND SWING CRANES,
Operated by Electricity, Shafts or Independent Engines.
Turn Tables, Testing Machines, Shafting, Pulleys, Hangers, Couplings, Etc.
INJECTORS FOR ALL CLASSES OF BOILERS.





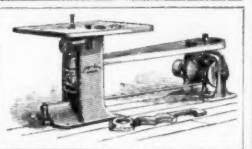
THE HILLES & JONES CO.,
WILMINGTON, DEL.
—MANUFACTURERS OF—
MACHINE TOOLS
—FOR—
Boiler Makers, Bridge Builders, Ship Builders, Railroad Shops, Locomotive and Car Builders, etc.
CUT SHOWS OUR SINGLE SHEAR WITH CRANE.
SEE OUR EXHIBIT AT WORLD'S FAIR.

THE LONG & ALLSTATTER CO.
HAMILTON, OHIO, U. S. A.



POWER PUNCHING and SHEARING MACHINERY.
For Ship Builders, Boiler Makers, Bridge Works, Architectural Iron Works, Carriage and Wagon Makers, Agricultural Implements, etc., etc.
Correspondence stating requirements solicited.

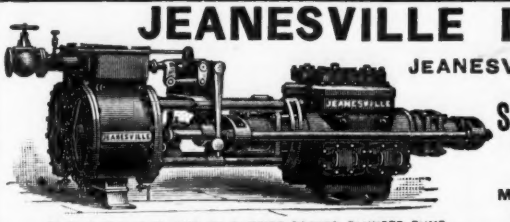
NEARLY 1,000 DIFFERENT MACHINES.



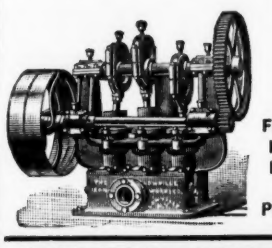
J. A. FAY and EGAN CO.,
239 to 259 W. FRONT ST., Cincinnati, Ohio, U. S. A.
OWNERS AND OPERATORS OF THE EGAN CO.
J. A. FAY & CO., Established 1855. 1873.
LARGEST LINE IN THE WORLD OF THE LATEST RESULTS OF AMERICAN INGENUITY.
MAKERS OF WOOD-WORKING MACHINERY FOR ANY PURPOSE.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
MACHINIST,
Successor to
BREHMER BROS.,
410 N. 12th St., Philadelphia, Pa.

JEANESVILLE IRON WORKS,
JEANESVILLE, LUZERNE CO., PA.,
BUILDERS OF
SPECIAL PUMPS OF ALL KINDS.
DUPLEX OR SINGLE,
SIMPLE OR COMPOUND.
MINE PUMPS, SINKING PUMPS PRESSURE PUMPS, VACUUM PUMPS, ARTESIAN WELL PUMPS POWER PUMPS, ETC., ETC.

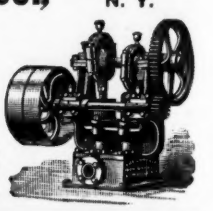

24 IN. X 10 X 12 IN. DUPLEX OUTSIDE PACKED PLUNGER PUMP.

LOWVILLE IRON WORKS CO., LOWVILLE, N. Y.
MANUFACTURERS OF
PUMPS

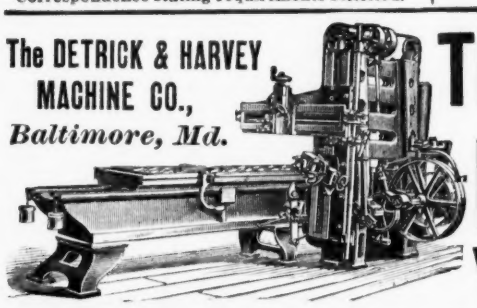


For Boiler Feeding, Elevator Work, Pulp Mills.

and other purposes. Send for Circular.



The DETRICK & HARVEY MACHINE CO.,
Baltimore, Md.

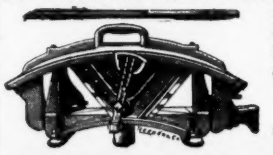


The Open Side Iron Planers.
WRITE DIRECTLY TO US FOR CATALOGUE AND PRICES.

THE VERNON COUNTING REGISTER.

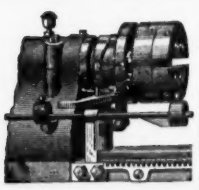
Positive Motion, Steel Gearing, Brass Wheels.
Absolutely Accurate at High Speed.
For Counting Strokes of Engines, Pumps, Speed of Shafting and Automatic Machines, Registering Fares in Turnstiles, etc., etc.
THE DAVIDS MACHINE WORKS,
MANUFACTURERS AND SOLE AGENTS.
OFFICES: 129 WORTH ST., NEW YORK.

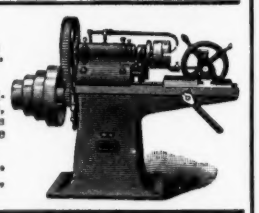
THE PERKINS DRAW STROKE TRIMMER,



An Indispensable Tool for all Bench Woodworkers. Latest and Best Design. Infringers Prosecuted. Trial, not orders, solicited.
PERKINS & CO.,
Grand Rapids, Mich.
STOCKS, NEAVE & CO.,
Manchester, England.

ADAMS
Automatic Bolt-Threading & Nut Tapping Machine.
Made in all Sizes to Cut from 1-4" to 6".
The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to
Capitol Mfg. Co., 125 to 137 Rees St., Chicago, Ill., U. S. A.
Agents for Great Britain, CHARLES CHURCHILL & CO., Ltd., 21 Cross Street, Finsbury, London, E. C., England.



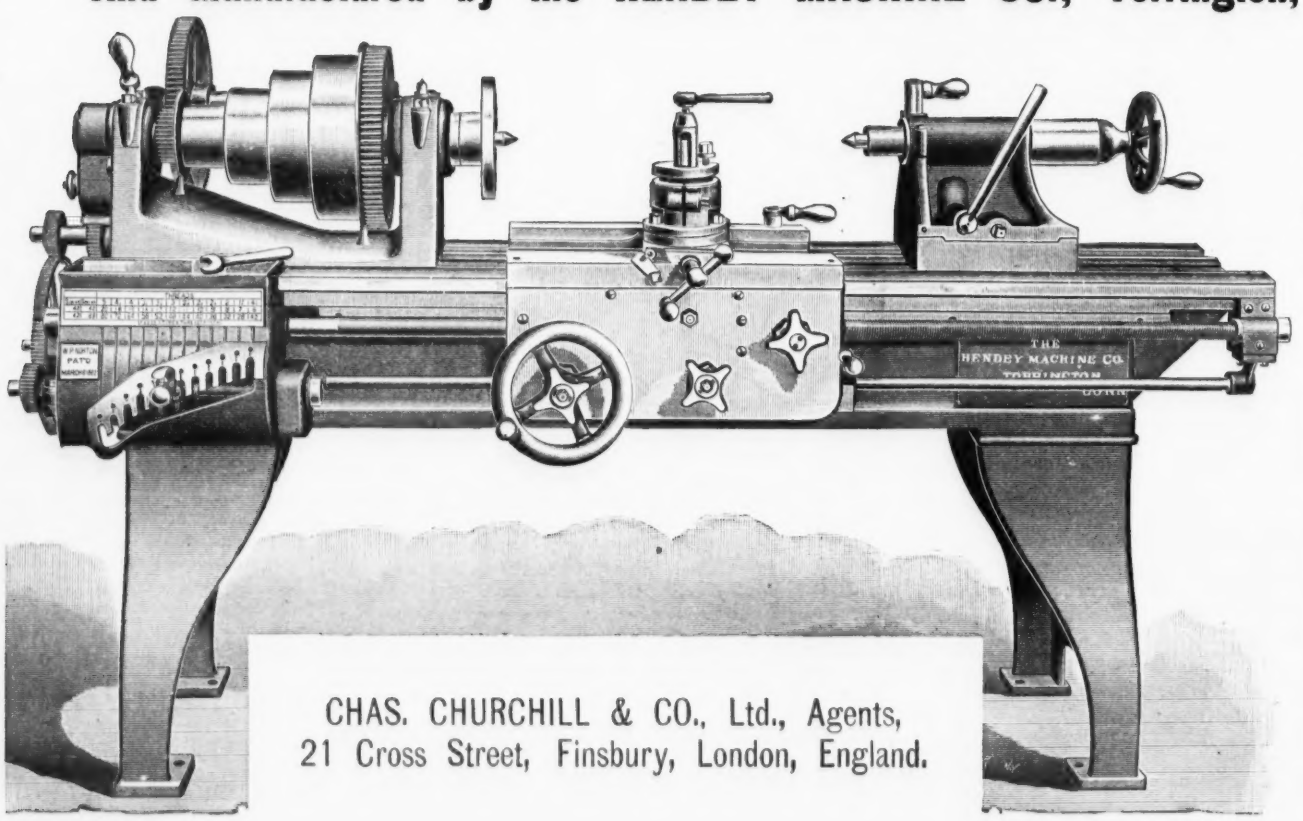


ROBERT POOLE & SON CO.
ENGINEERS & MACHINISTS.
TRANSMISSION MACHINERY
MACHINE MOULDED GEARING
SPECIAL FACILITIES FOR THE HEAVIEST CLASS OF WORK
BALTIMORE, MD.

CHAS. A. STRELINGER & CO.,
Tools, Supplies and Machinery,
DETROIT, MICH.

CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK

THE NORTON IMPROVED SCREW-CUTTING ENGINE LATHE,
PATENTED MARCH 8TH, 1892,
And Manufactured by the HENDEY MACHINE CO., Torrington, Conn., U. S. A.



CHAS. CHURCHILL & CO., Ltd., Agents,
21 Cross Street, Finsbury, London, England.

THIS LATHE

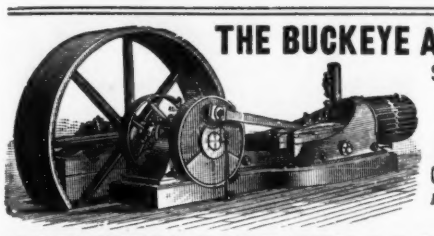
Cuts 12 different screws, 6 to 20 without changing the gears, and feed changes from 30 to 100 cuts per inch without change.

Has Hollow Spindle or not as preferred, Compound or Elevating Tool Rest, Power Cross Feed, Taper Attachment. Carriage reverses for screw cutting without the use of the counter shaft, from the lever at end of carriage, allowing the spindle to run in one continuous direction.

Lathe furnished to responsible parties on 30 days' trial.

Send for Descriptive Circular.

THE BUCKEYE AUTOMATIC CUT-OFF ENGINES.



SLOW SPEED, MEDIUM SPEED AND HIGH SPEED ENGINES,

Simple, Compound and Triple-Expansion Engines.

HIGH-PRESSURE BOILERS.

Complete Steam Power Plants of Highest Attainable Efficiency.

Address BUCKEYE ENGINE CO., Salem, O.

Or SALES AGENTS:

BUCKEYE ENGINE CO.'S SALES AGENCY, H. T. PORTER, No. 10 Telephone Building, New York City. A. A. HUNTING, John Hancock Bld'g, Boston, Mass. N. W. ROBINSON, 97 Washington St., Chicago, Ill. ROBINSON & CARY COMPANY, St. Paul, Minn. A. L. FISH, No. 61 First St., San Francisco, Cal. A. M. MORSE, 511 Commercial Building, St. Louis, Mo. J. M. ARTHUR & CO., Portland, Oregon.

ALBANY STEAM TRAP CO., ALBANY, N. Y.

RETURN STEAM TRAPS, SPECIAL

BOILER FEED PUMPS AND PUMP GOVERNORS.

AUTOMATIC

STEAM PUMPS AND GOVERNOR COMBINED FOR PUMPING HOT CONDENSED WATER.

Renewable Seat and Disc VALVES.

"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

63d & Walnut Streets, Philadelphia. 245 Lake Street, Chicago.

New York Agency, 18 Vesey St.

35,000 SOLD.

MANY NEW IMPROVEMENTS FOR USE WITH

COAL GAS, NATURAL GAS, PRODUCER GAS, OR GASOLINE. COMBINED

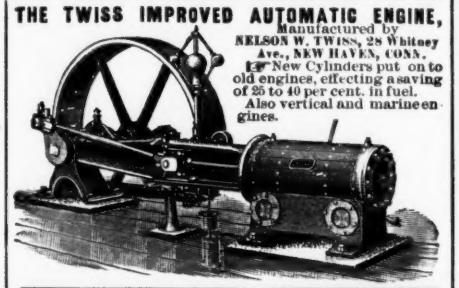
"OTTO" GAS ENGINES AND PUMPS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.

THE TWISS IMPROVED AUTOMATIC ENGINE,

Manufactured by NELSON W. TWISS, 28 Whitney Ave., NEW HAVEN, CONN.

New Cylinders put on to old engines, effecting a saving of 25 to 40 per cent. in fuel. Also vertical and marine engines.



STRONG, WELL BUILT SERVICEABLE STEAM ENGINES

12 to 100 Horse Power

Every Engine tested under full load.

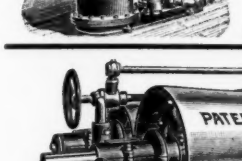
Adapted to Heavy, Continuous Work.

SUITABLE Tubular & Firebox BOILERS on hand for immediate delivery.

CHANDLER & TAYLOR CO. INDIANAPOLIS, IND.

CONOVER CONDENSERS.

STEAM.



BELT.

BELT AND STEAM DRIVEN.

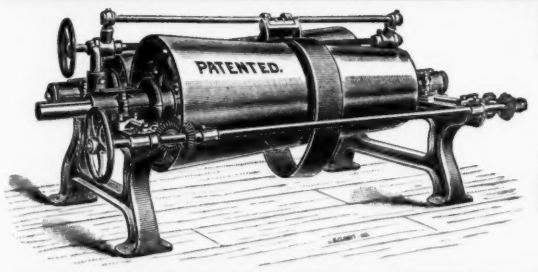
Compound Condensing Corliss Engine on Independent Condenser.

HANDSOME CATALOGUE FREE.

THE CONOVER MFG. CO.,

39 & 41 CORTLANDT STREET, N. Y.

EVANS FRICTION CONES



HANGING AND STANDING,

MADE IN ALL SIZES.

Thousands in use transmitting from 1 to 50 H. P. For information address,

EVANS FRICTION CONE CO.

No. 85 WATER STREET,

BOSTON, MASS.

LINK-BELT ENGINEERING CO.

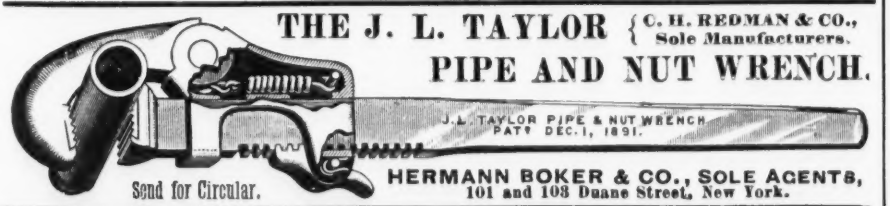
NICETOWN PHILA.

49 DEY ST. NEW YORK.

Elevators, Conveyors, Manilla Rope Power Transmission Machinery, Ewart Detachable Link Belting, Dodge Chain, Howe Chain, etc. (Chicago-Link-Belt Machinery Co.)

THE J. L. TAYLOR PIPE AND NUT WRENCH.

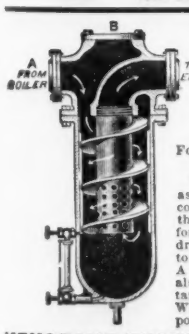
{C. H. REDMAN & CO., Sole Manufacturers.



Send for Circular.

HERMANN BOKER & CO., SOLE AGENTS, 101 and 103 Duane Street, New York.

DRY STEAM.



Simpson's Centrifugal Steam Separator.

For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.

Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.

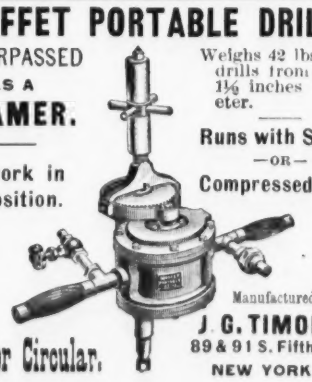
KEYSTONE ENGINE & MACHINE WORKS.

Fifth and Buttonwood Streets, Philadelphia.

MOFFET PORTABLE DRILL.

UNSURPASSED AS A REAMER.

Will work in any position.



Weighs 42 lbs. and drills from ⅜ to 1¼ inches diameter.

Runs with Steam —OR— Compressed Air.

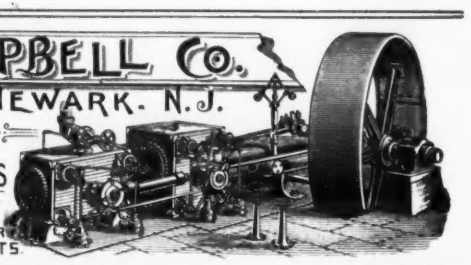
Manufactured by J. G. TIMOLAT, 89 & 91 S. Fifth Ave., NEW YORK.

Send for Circular.

THE WATTS, CAMPBELL CO.

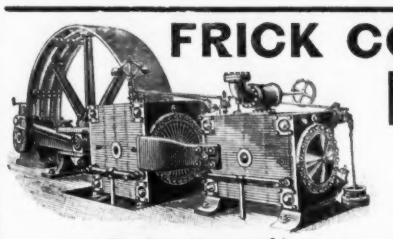
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N. J.



CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.

FRICK COMPANY, WAYNESBORO, PA.



(Tandem Compound.)

ECLIPSE CORLISS ENGINES,

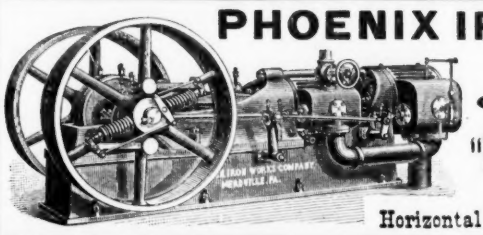
40 TO 2,000 H. P., ALL STYLES.

Send for Illustrated Catalogue.

ALSO BUILDERS OF

Electric High Speed Engines and Ice-Making and Refrigerating Machinery.

PHOENIX IRON WORKS CO.



MEADVILLE, PA.

New York, 15 Cortlandt St.

Chicago, 519 The Rookery,

Sole Manufacturers of the

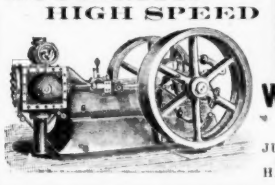
"Dick & Church" Automatic Cut-off Engine

Single, Tandem Compound, and Triple Expansion.

Horizontal Tubular and Manning Vertical Boilers.

WESTON AUTOMATIC HIGH SPEED ENGINES

HIGH PRESSURE BOILERS AND COMPLETE POWER PLANTS

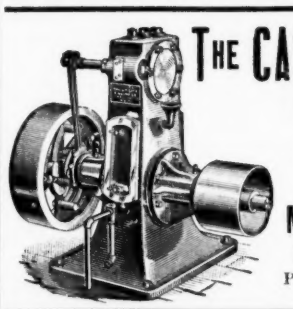


WESTON ENGINE CO., PAINTED POST, N. Y.

REPRESENTATIVES

JULIAN SCHOLL & CO., 126 Liberty St., N. Y.
GEO. D. HOFFMAN, 82 Lake St., Chicago.
H. M. SCIPLE & CO., 3d & Arch Sts. Phila, Pa.

THE CASE AUTOMATIC HIGH SPEED ENGINE



SIMPLICITY, COMPACTNESS.

Automatic Lubrication, Perfect Regulation,

The Latest Development in High Speed Engine Building.

BUILT IN SIZES FROM 2½ to 25 H. P.

Manufactured by THE J. T. CASE ENGINE CO.,

New Britain, Conn., WM. S. HINE, Gen'l Sales Mgr.

PIERCE & MILLER ENGINEERING CO., Selling Agents for New York and Export, 42 Cortlandt Street, N. Y.

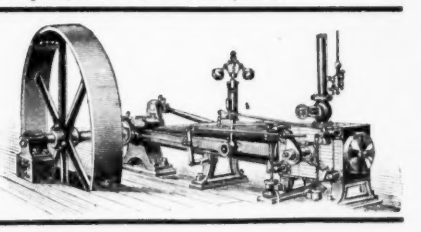
PHILADELPHIA CORLISS ENGINES,

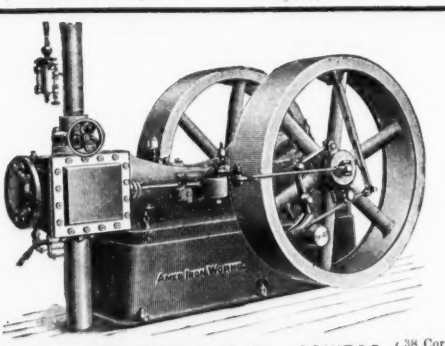
Simple, Compound and Triple-Expansion.

ALL SIZES.

Philadelphia Engineering Works, Ltd.

Mifflin St., East of Front, PHILADELPHIA, PA.

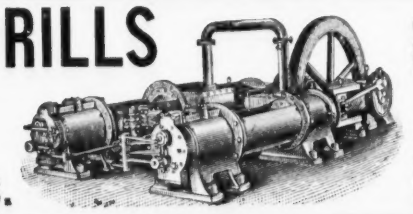




AMES IRON WORKS, OSWEGO, N. Y.

38 Cortlandt Street, New York City.
18 South Canal Street, Chicago, Ill.
50 Oliver Street, Boston, Mass.
518 Arch Street, Philadelphia, Pa.

ROCK DRILLS AND AIR COMPRESSORS.

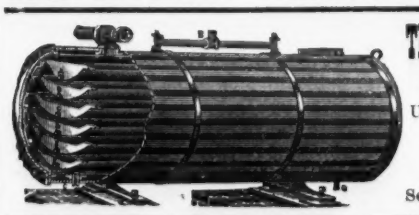


AIR COMPRESSORS WITH COMPOUND AIR CYLINDERS, AND COMPOUND STEAM CYLINDERS WITH MEYER OR CORLISS VALVES

RAND DRILL CO.,

23 Park Place, NEW YORK, U. S. A.

BRANCH OFFICES: Monadnock Building, Chicago; Ishpeming, Mich.; 1316 18th St., Denver; Sherbrooke, P. Q., Canada; Apartado 830, Mexico City.



The HOPPES Live-Steam Feed-Water Purifier,

Guaranteed to Prevent Scale in Boilers.

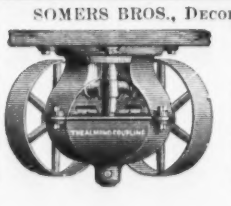
Using any kind of water. Hard Sheet Steel Troughs.

Easily Cleaned.

HOPPES MANUFACTURING CO.,

Send for Catalogue D. SPRINGFIELD, OHIO.

SOMERS BROS., DECORATED TIN BOXES, Third Ave., and Third St., Brooklyn, N. Y., May 4, 1893.



T. R. ALMOND, 83 Washington St., Brooklyn, N. Y.

DEAR SIR—In reply to your inquiry regarding your Right-angle Counter-shaft, which you sold us at the time we fitted up our new buildings in 1886, we are pleased to report that we have had your coupling in constant use since that time, and that it has given us universal satisfaction. We have never had the least difficulty with it in any way, and by simply supplying new oil once in two months it has run continuously since that time without any kind of repairs or overhauling and is now in as good a condition as when we bought it. By keeping its working bearings well supplied with oil the wear is imperceptible. This coupling is suspended to the iron column or beam, and is very rigid in its settings, hence it has not shifted or moved a particle by any warping of beams, and is directly connected with the shafts at right angles. The driving line being 300 feet and the driven line about 200 of 2-inch shafting. Yours very respectfully, SOMERS BROS.

BROWN & SHARPE MFG. CO.,
PROVIDENCE, R. I.

We are glad to show our tools, our shops and our methods to our visitors, and we would especially impress upon strangers from abroad that our establishment is only one of many fine ones in Providence, and that our State is not only a large manufacturing district, but also has one of the most beautiful and well-known watering places in the world.

Our city is one hour from Boston, five hours from New York, and twenty-six hours from Chicago.

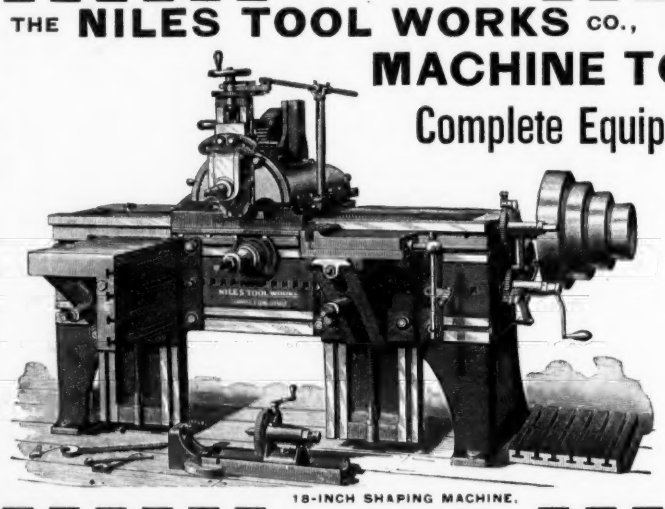
ENGLAND—BUCK & HICKMAN, 280 Whitechapel Road, London, E.
GERMANY G. DIECHMANN, Ansbacherstr, 5 Berlin, W. 62.
FRANCE—FENWICK FRERES & CO., 21 Rue Martel, Paris.
" F. G KREUTZBERGER, 140 Rue de Neuilly Puteaux (Seine).
CHICAGO, ILL.—FRED. A RICH, 23 South Canal Street, and World's Columbian Exposition, Machinery Hall Annex, Section 13, Crane Columns J, 46 and 47 Centre Aisle.

SEE OUR EXHIBIT, WORLD'S FAIR.

THE **NILES TOOL WORKS** CO., HAMILTON, OHIO.

MACHINE TOOLS.

Complete Equipments.



NEW YORK,
CHICAGO,
BOSTON,
PHILADELPHIA,
PITTSBURGH.

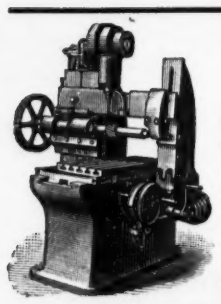
18-INCH SHAPING MACHINE.

SEE OUR EXHIBIT, WORLD'S FAIR.

JENKINS STANDARD PACKING

for Steam or Joint Packing, has no superior. It is manufactured in all thicknesses. It is **not loaded** to increase weight. Does **not rot or burn out.** Every sheet is stamped with Trade Mark, like cut.

JENKINS BROS.,
NEW YORK, PHILADELPHIA, BOSTON and CHICAGO.

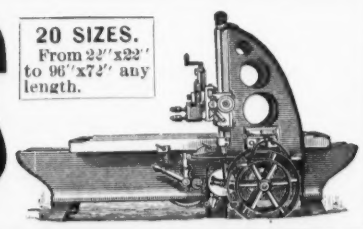


BEMENT, MILES & CO.,
PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS
ROLLING MILLS, STEAM FORGES, SHIP YARDS, BOILER SHOPS,
BRIDGE WORKS, ETC., ETC

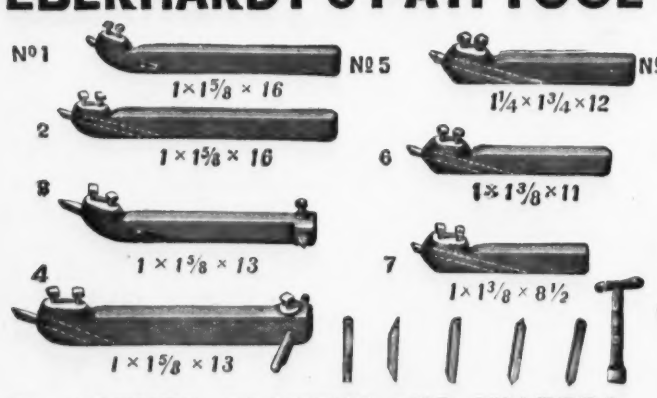
New York Office, Equitable Building, GEO. PLACE, Agent.

SPUR- AND SPIRAL-GEARED
PLANERS
("SELLERS' MOTION")
MADE BY
The G. A. GRAY CO.,
477-483 SYCAMORE ST., CINCINNATI, O.

20 SIZES.
From 22"x22" to 96"x72" any length.



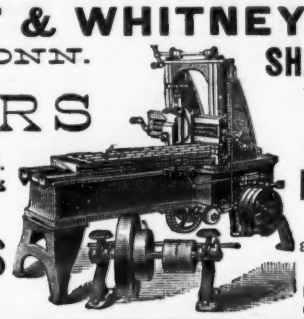
EBERHARDT'S PAT. TOOL HOLDER



For LATHES, PLANERS AND SHAPERS.
IT NEVER REQUIRES FORCING.
NO STOCK OF HEAVY STEEL ON HAND.
WILL SAVE ITS COST IN A FEW DAYS.
WRITE FOR DESCRIPTIVE CIRCULARS
To COULD & EBERHARDT, NEWARK, N. J.

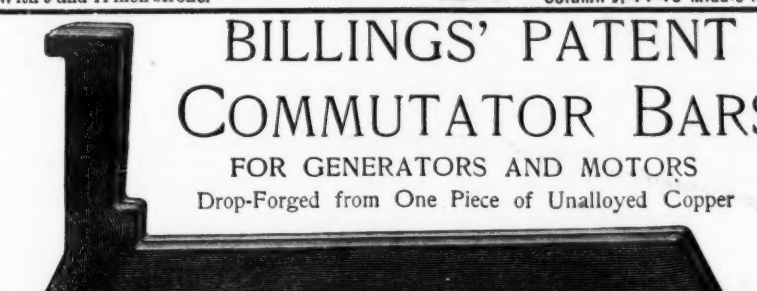
Tools can be seen in operation in Manning, Maxwell & Moore's Machine shop, Annex Machinery Hall World's Columbian Exposition, Chicago Ill.

THE PRATT & WHITNEY COMPANY,
HARTFORD, CONN.
MANUFACTURE
PLANERS
To plane 16 in. x 16 in. x 3 ft. to 40 in. x 40 in. x 20 ft with quick return motion.
PILLAR SHAPERS
With 9 and 14 inch stroke.

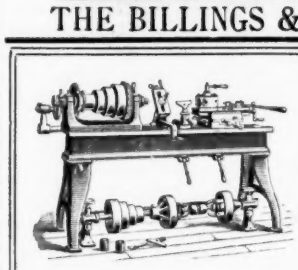


SHAPING MACHINES
With 12 in. and 14 in. stroke, all feeds automatic.
Single and Double Head
MILLING MACHINES
Description and Prices sent on application.
Exhibit at the World's Columbian Exposition, Machinery Hall, Crane Column J, 44-45 Middle Annex.

BILLINGS' PATENT
COMMUTATOR BARS
FOR GENERATORS AND MOTORS
Drop-Forged from One Piece of Unalloyed Copper



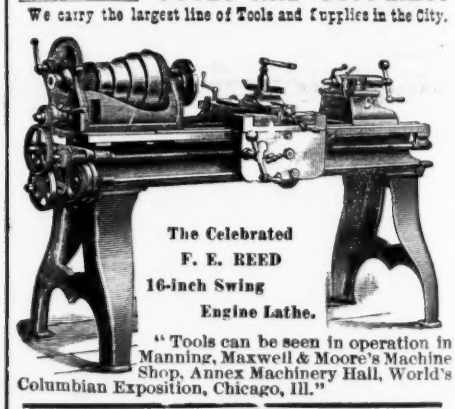
THE BILLINGS & SPENCER CO., Hartford, Conn.



WARNER & SWASEY,
CLEVELAND, OHIO.
MANUFACTURERS OF
UNIVERSAL MONITORS.
IRON AND BRASS WORKING MACHINERY.
SEND FOR ILLUSTRATED CATALOGUE.

GEO. W. FIFIELD,
MANUFACTURER OF
ENGINE LATHES
FROM 17 TO 50 IN. SWING.
Cuts, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.

MANNING, MAXWELL & MOORE,
111-113 LIBERTY ST., NEW YORK.
Manufacturers and Dealers in all kinds of
RAILWAY and MACHINISTS' **TOOLS AND SUPPLIES.**
We carry the largest line of Tools and Supplies in the City.



The Celebrated F. E. REED 16-inch Swing Engine Lathe.

"Tools can be seen in operation in Manning, Maxwell & Moore's Machine Shop, Annex Machinery Hall, World's Columbian Exposition, Chicago, Ill."

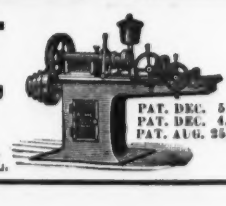
PRICES REDUCED
ON
20 in. W. & L. DRILLS.
LARGE STOCK,
QUICK DELIVERY.
Write for Catalogue and Prices.
W. P. DAVIS,
Rochester, N. Y.

WYMAN & GORDON.
WORCESTER, MASS.
DROP FORGINGS.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

THE ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of
ACME BOLT & RIVET HEADERS,
Acme Single & Double Automatic BOLT CUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM CINCINNATI CENTENNIAL.



SEE
OUR ADVERTISEMENT,
PAGE 18.
THE HENDEY MACHINE COMPANY,
TORRINGTON, CONN.

Manufacturer —of— **TAPS & DIES**